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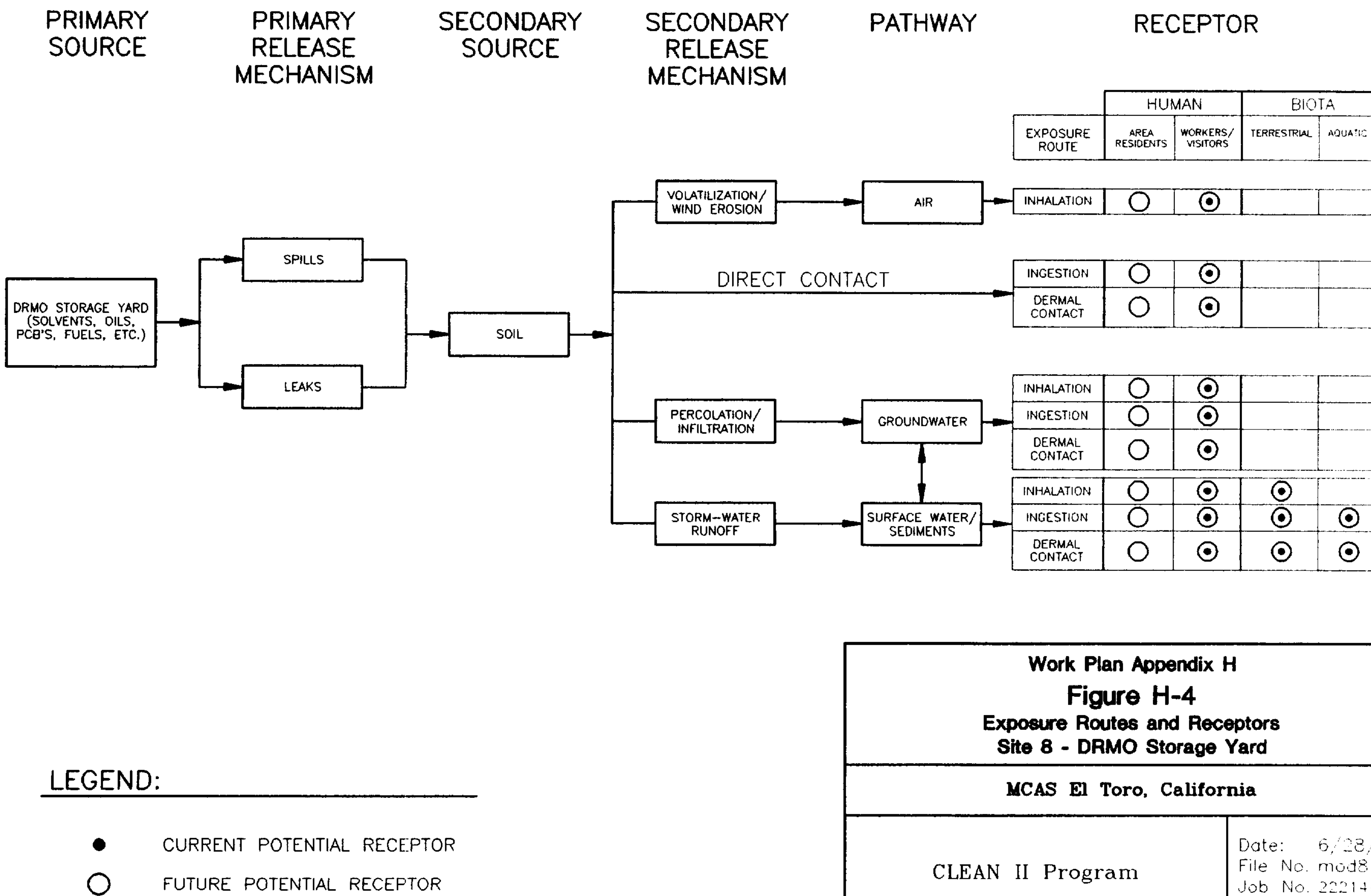


Work Plan Appendix H

Figure H-4

Exposure Routes and Receptors
Site 8 - DRMO Storage Yard

MCAS El Toro, California

CLEAN II Program

Date: 6/28/95
File No. mod8
Job No. 22214-059

The primary release mechanism is contaminants released to surface and shallow soil from spills and leaks that occurred frequently in the Storage Yard. Eventually under gravity, contaminants present in surface and shallow soil may move downward with soil moisture (as dissolved phase) or as a discrete liquid phase. The depth of groundwater at this site is reported to be at a depth of about 120 feet bgs.

The secondary source of contaminants is the surrounding soil impacted by the primary release mechanism (spills and leaks). Fugitive dust release is unlikely with chemicals stored in liquid form. In case of chemicals stored in a fine powder form, dust release is a possible secondary release mechanism. Volatilization of organic chemicals is another possible secondary release mechanism at this site. Also, percolation or infiltration of contaminants present in impacted surface soil to subsurface soil is considered another secondary release mechanism.

The potential pathways are air and groundwater. Surface water is an unlikely pathway at this site. Airborne contaminants are transported through fugitive dust and volatilization. The transport through air is affected by wind speed and direction, type of contaminant, and weather condition. Typical wind condition at MCAS El Toro is from west/southwest at less than 10 knots. Because many VOCs and SVOCs have been in storage at this site, transportation of airborne contaminants through volatilization is a possible pathway. The mean annual rainfall at MCAS El Toro is about 14.0 inches; most of it occurs from November through April.

Current and/or potential receptors of chemicals at this site via inhalation are workers and visitors involved in storage activities. Direct contact with surface and subsurface soils is currently possible via dermal or ingestion exposures of workers. Infiltration of contaminated water through the vadose zone into groundwater is minimal because the groundwater is at 120 feet bgs, rainfall is only 14 inches per year, and the current storage yard is covered with a concrete pavement. However, current exposure of workers is unlikely via ingestion of groundwater at this site.

Terrestrial wildlife could be exposed to chemicals in on-site surface soil and to dust and vapors through ingestion, dermal absorption, or inhalation. Terrestrial plants could also be exposed through root absorption of chemicals in surface soil or deposition of dusts. No special-status species were observed at this site, and the immediate area provides marginal habitat for wildlife species.

Removal Action

In meeting with the Base Realignment and Closure (BRAC) Cleanup Team (BCT) in June 1995, Units 1 and 4 of Site 8 were designated for Removal Action. This designation occurred because the nature and extent of contaminants is known and criteria of a Non-Time-Critical Removal Action were satisfied (Section 5 of the Work Plan). An Engineering Evaluation/Cost Analysis (EE/CA), Action Memorandum, and a community relations plan are being prepared for this removal action. During the same series of meetings, Unit 2 of Site 7 was designated for No Further Investigation (NFI) with the agreement that investigations for Site 24 (VOC Source Area) will assess the presence of volatile organics in this unit.

Statement of Phase II RI/FS Problem

Site 8 is located in the southwest corner of the South Marine Way and R Street in the southern quadrant of MCAS El Toro. The problems associated with this site are the following:

- shallow soil is contaminated with compounds including VOCs, SVOCs, pesticides and PCBs, metals, and petroleum hydrocarbons;
- although groundwater beneath Site 8 is contaminated with VOCs, it does not appear that Site 8 is a source of these VOCs;
- based on LUFT guidelines, petroleum hydrocarbons detected in shallow soil may pose a threat to groundwater; and
- additional data are necessary to calculate a cumulative excess cancer risk and hazard index as well as determine further actions for the site.

STEP 2 – IDENTIFY THE DECISION

This step describes the decisions that will be considered during the DQO process for Site 8. For each decision, the alternative outcomes are stated. The Sampling Decision Process is illustrated on Figure H-5. For Site 8, the following decisions will be considered:

1. Do COPCs in shallow soil (less than 10 feet bgs) in the unit exceed established background concentrations and PRGs, and/or do they present an unacceptable risk to human health or the environment?

   If yes, proceed to the next decision.

   If uncertain, collect additional soil samples to determine risk.

   If no, recommend the unit for NFI.

2. Has the extent of impacted soil been defined in the shallow soil?

   If yes, evaluate a response action.

   If no, conduct soil sampling to define extent.

3. Does the extent of impacted shallow soil extend into the subsurface (greater than 10 feet bgs)?

   If yes, conduct soil sampling to define vertical extent of impacted soil, and if necessary, evaluate potential impacts to groundwater beneath the site.

   If no, evaluate a response action.

4. Does the medium being evaluated for a response action qualify for Early Action?

   If yes, recommend unit for an EE/CA.

   If no, recommend unit for a remedial response as part of the RI/FS process.

STEP 3 – IDENTIFY THE INPUT AFFECTING THE DECISION

Step 2 defined the decisions addressing possible actions at the site. Step 3 will identify the inputs that are required to assess the actions as discussed below.

Inputs for No Further Investigation

Input information required to support an NFI recommendation will also be used to support decisions for Early Action and Long-Term Action. These inputs are as follows:

- list of COPCs;
- definition of the extent of impacted soil;
- background concentrations for metals, pesticides, and herbicides;
- determination of risk for the unit; and
- action levels for the protection of human health and the environment.

Inputs for Early Action

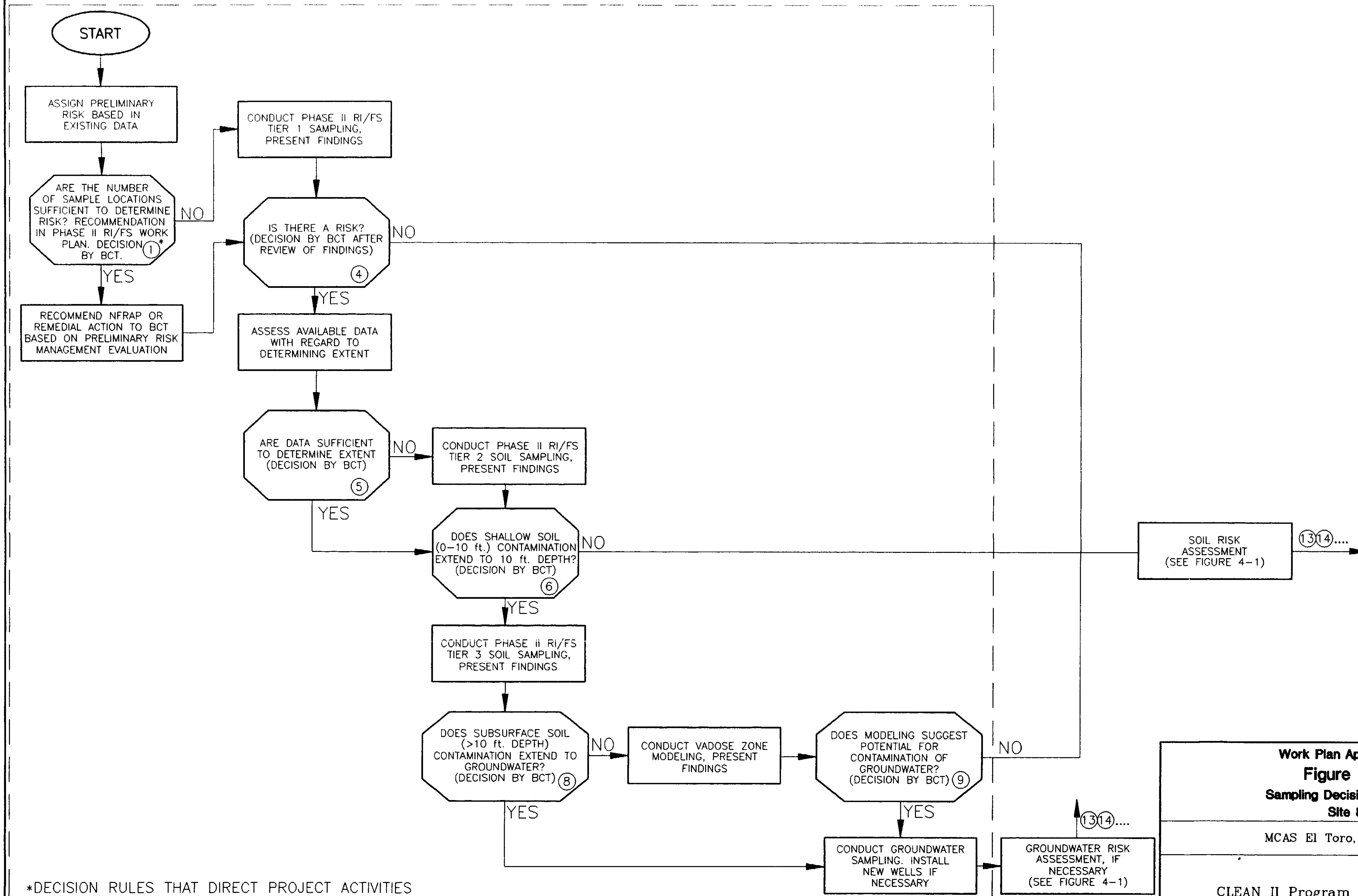
In addition to the inputs required for an NFI recommendation, input information required to support an Early Action recommendation will include the following:

- applicable or relevant and appropriate requirements (ARARs);
- identification of cleanup standards;
- identification of cleanup technology applicability/limitations that are not extensive operation and maintenance activities; and
- site/unit cleanup in less than 5 years.

Inputs for Long-Term Action

In addition to the inputs required for an NFI recommendation, input information required to support a Long-Term Action recommendation may include the following:

- ARARs;
- identification of cleanup standards;
- identification of cleanup technology applicability/limitations;
- pilot testing of remedial alternatives; and
- site/unit cleanup in more than 5 years.



Work Plan Appendix H

Figure H-5

Sampling Decision Process

Site 8

MCAS El Toro, California

CLEAN II Program

Date: 3/11/95
File No. Logicr8
Job No. 22214–059

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Descriptions of Inputs

The following subsections discuss the inputs required to assess possible response actions.

CHEMICALS OF POTENTIAL CONCERN

COPCs for Site 8 include the chemicals detected in the Phase I RI for each medium (Jacobs Engineering 1993a, pages A8-4 to A8-7). The COPCs for Site 8 are listed below.

Shallow Soil

- metals: aluminum, antimony, arsenic, barium, beryllium, cadmium, chromium*, cobalt, copper, lead, manganese, mercury, nickel, selenium, silver, thallium, vanadium, zinc;
- VOCs: 2-butanone, 2-hexanone, acetone, ethylbenzene, methylene chloride, tetrachloroethene, xylenes;
- SVOCs: benzo(a)pyrene, benzo(g,h,i)perylene, benzyl butyl phthalate, bis(2-ethylhexyl)phthalate, chrysene, dimethyl phthalate, di-n-butyl phthalate, fluoranthene, hexachloroethane, indeno(1,2,3-cd)pyrene, pyrene;
- pesticides and PCBs: alpha chlordane, 4,4'-DDE, dieldrin, PCB Aroclor 1254, PCB Aroclor 1248, PCB Aroclor 1260,
- fuel and petroleum hydrocarbons: TFH-gasoline, TFH-diesel, TRPH.

Subsurface Soil

- metals: aluminum, antimony, arsenic, barium, beryllium, cadmium, chromium*, cobalt, copper, lead, manganese, mercury, nickel, selenium, silver, thallium, vanadium, zinc;
- VOCs: 2-butanone, 2-hexanone, acetone, carbon disulfide, methylene chloride, ethylbenzene, methylene chloride, tetrachloroethene, toluene, xylenes;
- SVOCs: benzo(a)pyrene, benzo(g,h,i)perylene, benzyl butyl phthalate, bis(2-ethylhexyl)phthalate, chrysene, dimethyl phthalate, di-n-butyl phthalate, fluoranthene, hexachloroethane, indeno(1,2,3-cd)pyrene, pyrene;
- pesticides and PCBs: 4,4'-DDE, BHC-delta, alpha chlordane, dieldrin, endosulfan sulfate,; and
- fuel and petroleum hydrocarbons: TFH-gasoline, TFH-diesel, TRPH.

Groundwater-Upgradient

- metals: arsenic, barium, cadmium, chromium, copper, manganese, nickel, selenium, thallium, vanadium, zinc; and
- VOCs: chloroform, toluene, trichloroethylene, xylenes.

Groundwater-Downgradient

- metals: aluminum, antimony, arsenic, barium, cadmium, chromium, copper, manganese, mercury, nickel, selenium, vanadium, zinc; and
- VOCs: 1,1,2-trichloroethane, 1,1-dichloroethene, benzene, carbon tetrachloride, chloroform, chloromethane, tetrachloroethane, trichloroethylene.

* = Soil samples will be field screened for total chromium, if the sample result indicates a concentration of chromium of 50 parts per million (ppm) or greater, then the soil sample will be further analyzed for hexavalent chromium by a fixed base laboratory under Naval Facilities Engineering Service Center (NFESC; formerly known as NEESA) Level D protocol.

THE NATURE AND EXTENT OF CONTAMINATION

Phase II RI/FS sample locations, depths, and chemical analyses have been designed to assess the risk associated with the site. Additional sampling will be conducted if it is necessary to further define the extent of impacted shallow soil, subsurface soil, or groundwater.

BACKGROUND CONCENTRATIONS

The background concentrations for metals, herbicides, and pesticides are presented in Section 4 of the Work Plan.

DETERMINATION OF RISK

A determination of the human health risk associated with each site is based on a baseline or streamline risk assessment. Baseline risk assessments are performed on RI/FS sites. The objective of a baseline risk assessment is to estimate the risks associated with the no action alternative and thereby provide decision makers information useful in identifying the most appropriate remedial action alternative. The risk estimates produced also serve as a benchmark to which reductions in risk achieved by remedial actions may be compared. Streamlined risk assessments are performed on removal action sites to support the removal action.

In addition to the human health risk assessment conducted for a site, an ecological risk assessment may also be performed. The ecological risk assessment will evaluate current and potential risks to the environment posed by the chemical releases that have occurred at the sites.

IDENTIFICATION OF CLEANUP LEVELS

Cleanup levels will be based on ARARs, background concentrations, and risk levels that will be determined for the site.

CLEANUP TECHNOLOGY EFFECTIVENESS, IMPLEMENTABILITY, AND COSTS

Once cleanup levels have been established, the most appropriate and cost-effective approach will be identified to remedial the site, if necessary.

STEP 4 – DEFINE THE BOUNDARIES OF THE STUDY

This step defines the spatial and temporal boundaries of the problem and any practical constraints that may interfere with the study.

- Unit 1 – Eastern Storage Yard (approximately 59,100 $feet^2$ and has the same boundaries as Phase I RI, Site 8, Stratum 1);
- Unit 2 – West Storage Yard (approximately 118,900 $feet^2$ and has the same boundaries as Phase I RI, Site 8, Stratum 2);
- Unit 3 – Refuse Pile Area which is the soil under the former location of the refuse pile (approximately 3,750 $feet^2$ and is located in the north-central portion of Unit 2);
- Unit 4 – PCB Spill Area (approximately 1,500 $feet^2$ and has the same boundaries as Phase I RI, Site 8, Stratum 4); and
- Unit 5 – Old Salvage Yard (approximately 104,160 $feet^2$ and has the same boundaries as Phase I RI, Site 8, Stratum 5).

Specification of temporal boundaries for the field sampling activities is unnecessary. Shallow and deeper subsurface soil conditions are not considered to be significantly different from conditions during the Phase I RI sampling or throughout the period since spillage or unregulated waste disposal activities occurred on the site.

STEP 5 – DEVELOP A DECISION RULE

Decision rules are required to state explicitly the types of inputs and logical basis for choosing among alternative actions during the Phase II RI/FS. A list of all decision rules for the project are included in Section 4 of the Work Plan. The specific decision rules that will be followed to determine an action are described below:

2. If Phase I data are sufficient to assess a response action to reduce risk associated with site units which exceed medium action levels or background concentrations, then the cleanup levels and appropriate response action (Early Action or Long-Term Action) will be determined.
3. If Phase I data are not sufficient to assess whether risks are present based on the minimum number of samples, then Tier 1 sampling of the Phase II RI/FS will be completed to supplement the Phase I analytical results so the minimum number of samples is satisfied to assess whether action levels or background concentrations are exceeded in site units.

4. If Phase I data and Tier I data for the Phase II RI/FS indicate that no solid wastes are exposed, and respective action levels or background concentrations for the various medium of a site unit are not exceeded, then a NFI will be recommended.

5. If Phase I data or Tier 1 data of the Phase II RI/FS combined with Phase I data exceed PRGs, action levels, or background concentrations for the various medium, then Tier 2 of the Phase II RI/FS sampling and analyses will be conducted to define horizontal and vertical extent, provided additional sampling costs are not more than a potential response action.

6. If PRGs, action levels, or background concentrations for shallow soil are exceeded, and if COPCs detected in the soil extend to 10 feet bgs, then soil below 10 feet bgs (subsurface soil) will be investigated to assess the horizontal and vertical extent of the COPCs.

7. If during the investigation of COPCs in subsurface soil, two consecutive soil sample analyses (at a minimum 5-foot-depth separation) demonstrate that COPCs are not detected, then the vertical extent of soil contamination will be established and investigation of subsurface soil will be halted at that location. The horizontal extent will be established when COPCs are not detected in vertical samples taken at three locations around the sample that exceeds the action levels.

   The lowest detection limit available will be used to define the base of a contaminant plume. COPC detection or quantitation limits that will be compared to establish the base of the contaminant plume include the following:

   - CRDL,
   - contract-required quantitation limit (CRQL),
   - sample quantitation limit (SQL),
   - estimated quantitation limit (EQL),
   - practical quantitation limit (PQL),
   - method detection limit (MDL), and
   - IDL.

8. If during the investigation of COPCs in subsurface soil, it is determined by actual sampling that COPCs extend to the water table, groundwater beneath the site will be investigated for the presence of the COPCs.

9. If COPCs are identified in subsurface soil below 10 feet bgs, above background and action levels, but do not extend to the water table, then vadose zone computer modeling will be used to evaluate the potential for the COPCs to impact groundwater.

10. If it is determined that COPCs in subsurface soil have impacted groundwater causing exceedance of action levels, then the vertical and horizontal extent of groundwater exceedance will be evaluated.

13. If action levels or background concentrations are exceeded for the medium of a site unit, then the risk assessment will be initiated, based on sample results, acceptable levels of risk, and potential land uses, to assess potential risks to human health and/or the environment.

14. If unacceptable risks are assessed to human health or the environment, then cleanup levels will be evaluated for each medium.

15. If cleanup levels in a given medium are exceeded, and if the site meets at least one of the eight criteria for removal action described in 40 *Code of Federal Regulations* (CFR) 300.415(b)(2), and the scale and complexity of contaminant distribution in the affected medium are such that excess risk can be expediently reduced using readily available technology, then the medium at the site will be recommended for Early Action.

16. If an early removal action is selected, a Non-Time-Critical EE/CA and Action Memorandum will be completed for the removal action.

17. Once the removal action is completed, the site will be evaluated for residual risk. If a residual risk exists, then a long-term action may be required.

18. If cleanup levels for a given medium are exceeded, and if the site does not meet criteria for an Early Action, then the affected medium will be recommended for long-term remedial action as part of the RI/FS process; and an FS will be completed, followed by a Record of Decision (ROD), Remedial Design (RD), and Remedial Action (RA) to clean up the site for closure.

STEP 6 – SPECIFY LIMITS ON UNCERTAINTY

The purpose of Step 6 is to specify the tolerance limits for decision errors, which are used by the decision makers to establish performance goals for the data collection design. The objective of the data collection design is to obtain data that reliably estimate the true nature of environmental conditions at Site 8. This process is presented in Section 4 of the Work Plan, and the following subsections present specific information on Site 8.

Identify the Null Hypothesis and Specify the Decision Errors

The null hypothesis for this site specifies that the concentrations of one or more of the COPCs exceed PRGs or risk-based action levels and represent an unacceptable risk at the site.

The alternative hypothesis for this site specifies that the concentrations of one or more of COPCs do not exceed PRGs or risk-based actions levels and represent an acceptable risk at the site.

The false positive and false negative decision errors are discussed in Section 4 of the Work Plan.

Decision Errors Units

For the Phase II RI/FS, the allowable probability of making a false-positive decision has been designated as 0.05 (confidence of 95 percent) and an allowable probability of making a false-negative decision error has been designated as 0.20 (power of 80 percent).

Calculating the Number of Samples Necessary to Determine Risk

The number of sample locations necessary to determine the risk at a unit or a site were estimated using the process presented in Section 4 of the Work Plan. The number of additional sample locations needed to assess risk during the Phase II RI/FS is the difference between the total number of sample locations and the number of locations sampled during the Phase I RI (Table H-1).

Sampling Designs for the OU-3 Sites

Two types of sampling designs will be used to determine the soil conditions at Site 8. These two sampling designs are:

- stratified random sampling (either whole or partial unit areas, with replacement where sample locations are closely spaced or overlap); and
- areal systematic random sampling based on a grid.

Descriptions of these sampling designs are presented in Section 4 of the Work Plan. Both sampling designs use random positioning to produce an unbiased configuration of sample locations. The advantage of a random, unbiased sampling design is that the tolerance limits for false-positive and false-negative decision errors can be applied to the sample data and the risk decisions can be assigned a level of confidence.

STEP 7 – OPTIMIZE THE DESIGN

Historic site activities, previous site investigation results, and regulatory comments were used to formulate the Phase II RI/FS sampling approach. Shallow and deeper subsurface soils will be investigated at this site using a tiered sampling approach. This sampling approach consists of three tiers.

- The main focus of the Tier 1 sampling plan will be to determine whether the unit is a risk. The Tier 1 sampling approach will consist of collecting of shallow soil samples (less than 10 feet bgs) from a specific number of sampling locations within the unit. The number of sampling locations has been proposed, so that when the Phase I and II RI/FS data are evaluated together, an assessment of risk can be completed for the unit.
- The Tier 2 sampling approach will also focus on shallow soil; however, the primary objective will be to refine the extent of shallow soil that has been impacted by site activities by focusing on subareas of the unit where COPCs exceeded PRGs as identified by the Tier 1 sampling and/or Phase I RI/FS results.

Table H-1
Summary of Phase II RI/FS OU-3 Soil Sampling Strategies

Description	Unit Area	Estimated Risk[a]	Number of Locations/ Samples[b]	Number of Phase I Locations/ Samples	Number of Phase II Locations/ Samples	Tier	Type of Sampling Strategy
Site 8–DRMO Storage Yard	Unit 1–59,100 ft^2	5×10^{-5} (3)	6(18)	4(9)	2(8)	1	Stratified Random:w/replacement
	Unit 2–118,900 ft^2	(< 0.01)	NFRAP	3(7)	0	NA	No sampling proposed
	Unit 3–3,710 ft^2	(3.60)	4(12)	4(10)	4(14)	1	Areal Systematic Random
	Unit 4–1,560 ft^2	8×10^{-5}	6(18)	3(9)	3(9)	1	Stratified Random: partial area
	Unit 5–104,140 ft^2	(< 0.01)	14(42)	3(6)	6(18)[c]	1	Areal Systematic Random

Notes:

[a] These estimated cumulative cancer risk values were developed using Phase I RI data and COPC-specific risk-based concentrations developed following completion of Phase I RI activities. Numbers in parentheses are the estimated hazard index values.

[b] Number of samples based on comparison of estimated cancer risk to Table 4-7 in the Work Plan, which correlates four cancer-risk categories to the number of samples needed to determine that risk using the project-specific power and confidence limits. For this column, the first number represents sample locations, and the second number (in parentheses) is the number of samples based on an average of 3-depth intervals per sample location.

[c] These numbers represent the difference between the number of samples required to determine risk and the number of samples collected as part of the Phase I RI, with the following provisions:
Where Phase II RI/FS sample locations were recommended to determine risk, the area covered by this number of locations was based upon the U.S. EPA risk determination standard of a 40- x 40-meter block per sample location. This corresponds to an area of about 206,700 $feet^2$ for 12 sample locations. If the unit area is greater than this size limit, the maximum specified number of samples, less the Phase I RI number of samples, will be collected during the Phase II RI/FS. If the unit area is less than this size limit, the number of sample locations represents a ratio of the unit area versus the 12-sample area (206,700 $feet^2$) x 12 (e.g., Site 19, Unit 3: [Unit 3 area/206,700 $feet^2$]) x 2 locations = 9 locations needed - 3 Phase I locations = 6 new Phase II RI/FS locations required. Use of this ratio rule should maintain the necessary power and confidence limits at units where fewer samples are collected. At units where the ratio rule is applied, the total number of samples (Phase I and Phase II combined) will never be less than 6 despite the ratio calculation, to be sure that the minimum number of sample locations necessary for a risk assessment is collected. The number of Phase II RI/FS shallow soil boring locations has been based on three samples per location. However, at Site 8 (Unit 3) and Site 12 (Units 1, 2, and 4), four samples per location will be collected.

- The Tier 3 sampling approach has been designed to estimate the horizontal and vertical extent of impacted subsurface soil (greater than 10 feet bgs). This sampling strategy will only be implemented if Phase I RI/FS soil sample analytical data or Phase II RI/FS Tier 1/Tier 2 soil sample analytical data suggest impacted soil exists at depths greater than 10 feet bgs. Groundwater will be investigated if Phase I or Phase II soil data indicate potential impacts to groundwater are possible.

The tiered sampling approach is detailed in the following sections and in the FSP, Attachment H.

Tier 1

The Tier 1 of sampling will be collection of shallow samples from each unit within the site as described below. A summary of the number of sample locations, number of samples, and sample analyses is presented in Table H-2.

TIER 1 SOIL SAMPLING

Tier 1 sample locations will be positioned in areal systematic random (grid) sampling locations or stratified random sampling locations to characterize additional areas not sampled as part of the Phase I RI (Figure H-2). All Tier 1 soil samples collected at Site 8 will be field screened with a scintillometer for radio activity.

Unit 1: Eastern Portion of Storage Yard

Unit 1 has been approved for Early Action and is being addressed through the Non-Time-Critical Removal Action process. An Engineering Evaluation/Cost Analysis will be prepared for this unit.

Unit 2: Western Portion of Storage Yard

In the Phase II RI, Tier 1 soil samples will be collected at 0, 2, 4, and 10 feet bgs at five stratified random sampling locations. All soil samples will be field screened for polynuclear aromatic hydrocarbons (PAH) by immunoassay test kits (U.S. EPA Method 4035), VOCs (U.S. EPA Method 8010), TPH (U.S. EPA Method 8015M), and TAL metals (U.S. EPA Method 6000/7000) by an appropriately equipped mobile laboratory. All soil samples will be analyzed by a fixed-base laboratory for pesticides/PCBs (U.S. EPA Method 8080) under NFESC Level D protocols. For quality assurance/quality control (QA/QC) support and verification, six samples (four detects and two nondetects) will be submitted to the fixed-base laboratory to confirm field screening results. These fixed-base analyses are PAH (U.S. EPA Method 8310), VOCs (U.S. EPA Method 8010), TFH (U.S. EPA Method 8015M), and TAL metals (U.S. EPA Method 6000/7000 under NFESC Level D protocols. The FSP, Attachment H, describes the sampling procedures used for the Phase II RI/FS at Site 8, Unit 2 (BNI 1995).

Table H-2
Soil Sampling and Analysis

Tier	Unit/Name	PHASE II RI/FS SAMPLE NUMBERS			FIELD[a] - IMMUNOASSAY OR MOBILE LABORATORY					OFF-SITE LABORATORY[b]		
		No. of Locations	Samples/ Location	Total Samples	PAH[c]	PCBs[c]	VOCs[d]	TPH Gas and Diesel[d]	Target Analyte List - Metals[d]	PCBs and Pesticides[e]	Herbicides	Others:
Tier 1	Unit 2West Storage Yard	5	4	20	X		X	X	X	X		
	Unit 3 Refuse Pile	4	4	16	X			X	X	X		
	Unit 5 Old Salvage Yard	6	3	18	X		@ 10' only	X	X	X		
Tier 1 Subtotals				54	54		23	54	54	54		
Tier 2	Optional: Scope of Tier 2 would be to define extent of shallow soil contamination; based on Tier 1 data, and Phase I RI findings, RFA data, and soil gas survey results, with approval of BCT											
Tier 3	Optional: Scope of Tier 3 would be to characterize horizontal and vertical extent of contamination below 10 feet depth; based on Tier 1 and 2 data, and Phase I RI findings, and soil gas survey results, with approval of BCT											

Notes:
[a] at a minimum, 10 percent of detects and 5 percent of nondetects go to the off-site laboratory for confirmation analyses
[b] these constituents cannot be determined in the field; all samples to be analyzed for these constituents will be sent to the off-site laboratory
[c] immunoassay analyses
[d] mobile laboratory analyses
[e] all soil samples may not be analyzed for PCBs/pesticides; it is dependent upon the results of shallower soil analyses

Unit 3: Refuse Pile Area

Soil in the Refuse Pile Area has been excavated and removed to a depth of approximately 2 feet bgs. Phase I RI analytical results indicate PCB-impacted soil was present to a depth of 4 feet bgs. Therefore, soil samples will be collected at 0, 2, 4, and 10 feet bgs at four areal systematic random sampling locations based on a grid spacing of 33 by 20 feet to confirm the extent of the excavated soil and to estimate the remaining risk.

For the Phase II RI/FS Tier 1 sampling, all soil samples will be field screened for PAH by immunoassay test kits (U.S. EPA Method 4035), VOCs (U.S. EPA Method 8010), TPH (U.S. EPA Method 8015M), and TAL metals (U.S. EPA Method 6000/7000) by an appropriately equipped mobile laboratory. All soil samples will be analyzed by a fixed-base laboratory for pesticides/PCBs (U.S. EPA Method 8080) under NFESC Level D protocols. For QA/QC support and verification, four samples (three detect and one nondetect) will be submitted to the fixed-base laboratory to confirm field screening results. These fixed-base analyses are PAH (U.S. EPA Method 8310), VOCs (U.S. EPA Method 8010), TPH (U.S. EPA Method 8015M), and TAL metals (U.S. EPA Method 6000/7000) under NFESC Level D protocols. The FSP, Attachment H, provides the sampling procedures for the Phase II RI/FS at Site 8, Unit 1 (BNI 1995).

Unit 4: PCB Spill Area

Unit 4 has been approved for Early Action and is being addressed through the Non-Time-Critical Removal Action process. An Engineering Evaluation/Cost Analysis will be prepared for this unit.

Unit 5: Old Salvage Yard

The objectives of this investigation are to collect sufficient data on the fill material and underlying native soil to support the risk assessment and evaluate an NFI recommendation.

During the Phase I RI, three locations were sampled at 5, 10, 15, 20, and 25 feet bgs in Unit 5. However, these samples only reflect native soil conditions below 5 feet deep. The analytical results for soil indicate no COPCs detected in shallow soil exceed risk-based concentrations. Ecological screening criteria were not evaluated.

In the Phase II RI, Tier 1 soil samples will be collected at 0, 2.5, and 10 feet bgs at six areal systematic random sampling locations based on a grid of 142 by 127 feet. All soil samples will be field screened for PAH by immunoassay test kits (U.S. EPA Method 4035), VOCs (U.S. EPA Method 8010), TPH (U.S. EPA Method 8015M), and TAL metals (U.S. EPA Method 6000/7000) by an appropriately equipped mobile laboratory. All soil samples will be analyzed by a fixed-base laboratory for pesticides/PCBs (U.S. EPA Method 8080) under NFESC Level D protocols. For QA/QC support and verification, six samples (four detects and two nondetects) will be submitted to the fixed-base laboratory to confirm field screening results. These fixed-base analyses are PAH (U.S. EPA Method 8310), VOCs (U.S. EPA Method 8010), TPH (U.S. EPA Method

8015M), and TAL metals (U.S. EPA Method 6000/7000) under NFESC Level D protocols. The FSP, Attachment H, provides the sampling procedures for the Phase II RI/FS at Site 8, Unit 5 (BNI 1995).

Tier 2

The primary objective of the Tier 2 sampling program is to refine the extent of impacted soil identified within each unit by Phase I and/or II RI/FS sampling results. The Tier 2 sampling program will focus exclusively on shallow soil (0 to 10 feet depth) conditions and will further investigate subareas within the unit boundary that exceed PRGs.

The Tier 2 sampling plan will be developed after an evaluation of Phase I RI/FS and/or Phase II RI Tier 1 analytical results. If a Tier 2 sampling program meets the DQOs for this unit, the decision to proceed will be based upon the criteria described in DQO Steps 2, 3, and 5. The proposed Tier 2 sampling plan, with recommendations, will be reviewed by the BCT. The BCT will decide whether the proposed Tier 2 sampling program will be implemented by the Navy.

TIER 2 SOIL SAMPLING

As noted, the objective of a Tier 2 sampling program is to refine the extent of impacted shallow soil within the unit being investigated. The rationale for accomplishing this objective depends primarily on the size and layout of the unit. Where the unit is a linear feature such as a drainage ditch, the Tier 2 program will focus sampling along the trend of the ditch bracketing the Tier 1 sampling locations (or Phase I RI/FS sample locations) where analyte concentrations exceeding PRGs are reported.

For units of rectangular, roughly circular, or irregular dimensions, a systematic random sampling based on a grid, stratified random sampling, or judgmental sampling approach will be used to define the extent of the Tier 1 sample location(s) where analyte concentrations exceed PRGs. The limits of the area covered by these sampling approaches will be contingent upon the distribution of adjacent Tier 1 sample locations in which the COPCs were not detected.

The number of Tier 2 sampling locations (i.e., grid spacing) will be selected to achieve the following objectives:

- provide the areal coverage necessary to define the extent of shallow impacted soil; and
- minimize the cost associated with field and fixed-base laboratory sample testing.

The spacing between sampling locations for Tier 2 will be contingent upon the estimated size of the area to be investigated, and the spacing between Phase I or II RI/FS sample locations. Tier 2 soil sample depth intervals and chemical analyses will conform to those specified for Tier 1 soil sampling.

Tier 3

The Tier 3 sampling program would only be implemented at a unit where Phase I RI data, or the initial evaluation of the Phase II RI Tier 1 and/or Tier 2 sampling program results suggest that soil contamination may extend to depths greater than 10 feet bgs.

The objectives of the Tier 3 sampling program are to estimate the horizontal and vertical extent of impacted subsurface soil (greater than 10 feet bgs) and assess whether groundwater beneath the site has been impacted by historic site activities. If impacted subsurface soil is limited to the vadose zone above the water table or vadose zone modeling does not suggest a potential for COPCs to impact groundwater, then groundwater quality will not be investigated.

The Tier 3 sampling plan will be developed after an evaluation of Phase I RI/FS and Phase II RI Tier 1 and/or 2 analytical results. If a Tier 3 sampling program meets the DQO for this unit, then the decision to proceed will be based upon the criteria described in DQO Steps 2, 3, and 5. The proposed Tier 3 sampling plan, with recommendations, will be reviewed by the BCT. The BCT will decide whether the proposed Tier 3 sampling program will be implemented.

Optimization of Sampling Plan

As soil analytical data becomes available from sampling in each unit, investigative plans for the site will be optimized. The proposed tiered sampling approach is a reiterative process that will permit data from one tier to be evaluated before beginning the next tier of sampling. The reiterative process involves, review of data, recommendations for further actions, and approval of the BCT. In this way, the investigation can be optimized by performing the least amount of sampling necessary to assist the decision making process about future actions at the unit (i.e., NFI, Early Action, and Long-Term Action).

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DATA QUALITY OBJECTIVES
OPERABLE UNIT 3 –
SITE 9 – CRASH CREW PIT NO. 1

SUMMARY

STEP 1 – STATE THE PROBLEM

Site 9, the Crash Crew Pit No. 1 is the former location of two crash crew pits (east and west) that were utilized to train firefighters. Fuels and other fluids (JP-5, aviation gasoline, waste oil, and other wastes) that were used for burning in these pits during training may have impacted soil beneath the site.

Available information suggests that the impacted soil may be limited to the shallow soil interval at depths of less than 10 feet below ground surface. The human health and ecological risks associated with the impacted soil will be estimated so that a No Further Investigation or the appropriate remedial alternative can be recommended.

STEP 2 – IDENTIFY THE DECISION

The Phase II Remedial Investigation/Feasibility Study decisions to be considered at Site 9 are the following: Do chemicals of potential concern in the shallow soil at Site 9 present an unacceptable risk to human health and the environment? Are the chemicals of potential concern present in the subsurface soil (greater than 10 feet below ground surface), and if so, do they present an unacceptable risk to groundwater? The possible decision outcomes are recommendations for No Further Investigation, Early Action, or Long-Term Action.

STEP 3 – IDENTIFY THE INPUTS AFFECTING THE DECISION

Inputs necessary to make these decisions include a list of chemicals of potential concern; the extent of impacted media; the background (ambient) concentrations of metals, herbicides, and pesticides; and the action levels for protection of human health and the environment.

STEP 4 – DEFINE THE BOUNDARIES OF THE STUDY

The study is limited to the geographic area of Site 9, which comprises two subareas: 1) the Pit Areas (approximately 10,100 square feet); and 2) the Drainage Ditch (approximately 40,100 square feet), which includes the drainage area from the Crash Crew Pits to the catch basin. The second area was added to Site 9 for the Phase II Remedial Investigation/Feasibility Study to investigate the drainage area in the vicinity of the Crash Crew Pits.

STEP 5 – DEVELOP A DECISION RULE

Action levels developed for decision-making purposes are a cumulative excess cancer risk of 10^{-6} in humans; and a hazard index of 1.0 for chronic systemic toxicity in humans. Based on these risk levels, decision rules have been formulated to protect human health and the environment in residential, recreational, and industrial land use scenarios.

STEP 6 – SPECIFY LIMITS ON UNCERTAINTY

The number of samples necessary to estimate different levels of risk were calculated using the confidence level of 95 percent and power level of 80 percent limits specified for this project. The preliminary cancer and noncancer risk values were compared to the risk levels, and the appropriate number of samples necessary to estimate risk were selected for each unit.

STEP 7 – OPTIMIZE THE DESIGN

Shallow soil samples will be collected and analyzed at 0, 5, and 10 feet below ground surface from five locations in the Crash Crew Pit areas and six locations in the Drainage Ditch to assess soil potentially impacted by site operations in these areas.

ACRONYMS/ABBREVIATIONS

ARAR	applicable or relevant and appropriate requirement
BCT	BRAC Cleanup Team
bgs	below ground surface
BRAC	Base Realignment and Closure
COPC	chemical of potential concern
CRDL	contract-required detection limit
DQO	data quality objective
EE/CA	Engineering Evaluation/Cost Analysis
FS	Feasibility Study
FSP	Field Sampling Plan
IDL	instrument detection limit
LUFT	(California) Leaking Underground Fuel Tank (Field Manual)
MCAS	Marine Corps Air Station
MCL	maximum contaminant level
µg/kg	micrograms per kilogram
µg/L	micrograms per liter
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
NEESA	Naval Energy and Environmental Support Activity
NFESC	Naval Facilities Engineering Service Center
NFI	No Further Investigation
PAH	polynuclear aromatic hydrocarbons
pCi/L	picocuries per liter
PRG	(U.S. EPA Region IX) Preliminary Remediation Goal
QA/QC	quality assurance/quality control
RI	Remedial Investigation
RI/FS	Remedial Investigation/Feasibility Study

ACRONYMS/ABBREVIATIONS (continued)

SAIC	Science Applications International Corporation
SVOC	semivolatile organic compound
TAL	target analyte list
TDS	total dissolved solids
TFH	total fuel hydrocarbons
TPH	total petroleum hydrocarbons
TRPH	total recoverable petroleum hydrocarbons
U.S. EPA	United States Environmental Protection Agency
VOC	volatile organic compound

Appendix I
SITE 9 – CRASH CREW PIT NO. 1

The United States Environmental Protection Agency (U.S. EPA) developed the data quality objectives (DQO) process as a tool for project managers to determine the type, quantity, and quality of data needed to make decisions. Data produced by sampling and monitoring activities are used extensively in problem definition, rule-making, and enforcement decisions. These activities are supported through implementation of the mandatory U.S. EPA Quality System, which requires all organizations to develop and operate management processes and structures for assuring that the data collected are of the necessary and expected quality for their desired use (U.S. EPA 1993):

The U.S. EPA DQO process consists of the following seven steps.

1. **State the problem:** Describe the problem at the site as it is currently understood. The problem statement includes a site conceptual model and an organization and review of all relevant data.
2. **Identify the decision:** Determine an if-then statement that will define what the investigation will seek to determine and what actions will be taken based on the possible outcomes of the investigation.
3. **Identify inputs into the decision:** Specify the analytes or parameters to be measured and used.
4. **Define the study boundary:** Delineate the study boundary from information obtained from Step 1.
5. **Develop a decision rule:** Restate the decision detailing the if-then statement in specific terms.
6. **Specify acceptable limits on decision errors:** Specify how the data will be treated statistically and what the acceptable limits of uncertainty are.
7. **Optimize the design:** Design the field investigation, giving adequate consideration to the results of Steps 5 and 6. This step is described in more detail in the Field Sampling Plan (FSP).

The following sections describe the DQO process for Site 9 – Crash Crew Pit No. 1.

STEP 1 – STATE THE PROBLEM

Site 9 is the former location of two crash crew pits (east and west) that were utilized to train firefighters. Fuels and other fluids (JP-5, aviation gasoline, waste oil, and other wastes) that were used for burning in these pits during training may have impacted soil beneath the site.

Site Description

Site 9, Crash Crew Pit No. 1, is located in the western portion of the Marine Corps Air Station (MCAS) El Toro, to the northeast of Building 306, and just south of a taxiway for the east/west runway (Figure I-1). The site comprises two pits (east and west) that were utilized to train firefighters. Site boundaries for MCAS El Toro Phase I Remedial

Investigation (RI) were determined by consensus between the Navy and regulatory agencies prior to initiation of the Phase I RI. Areas of concern were generally grouped together into sites based on common historical activities, aerial photograph review, and their respective locations to each other.

From 1965 through 1971, an estimated 123,700 gallons of waste liquids were used in the west pit during training exercises (Jacobs Engineering 1993a). The west pit is estimated to have been approximately 150 feet long from east to west, and from 25 to 50 feet wide from north to south and 3 to 4 feet deep. During training, this pit was filled with water, then covered with various mixtures of residual fuels and fluids, (JP-5 fuel, aviation gasoline, possibly crankcase oil, and other wastes) and then the mixtures were ignited. Although the operational history of only the west pit is known, the operation of the east pit is believed to have been similar. From reviews of aerial photographs, the east pit appears to have been approximately 90 feet long from east to west, and about 60 feet wide from north to south with a depth that was most likely similar to the west pit.

The pits were filled in some time after 1971, and the terrain around both pits is now relatively flat and covered with vegetation. The east pit is partially covered by aircraft matting. Surface drainage from Site 9 flows northwest to a small swale. The swale empties into a storm drain located approximately 200 feet northwest of the west pit (Figure I-2). The storm drain eventually discharges into Bee Canyon Wash (Jacobs Engineering 1993a).

Previous Investigations

Several investigations have been conducted in the area of Site 9, these are the Phase I RI, aerial photograph surveys, and a soil gas survey. The sections below provide a summary of these investigations.

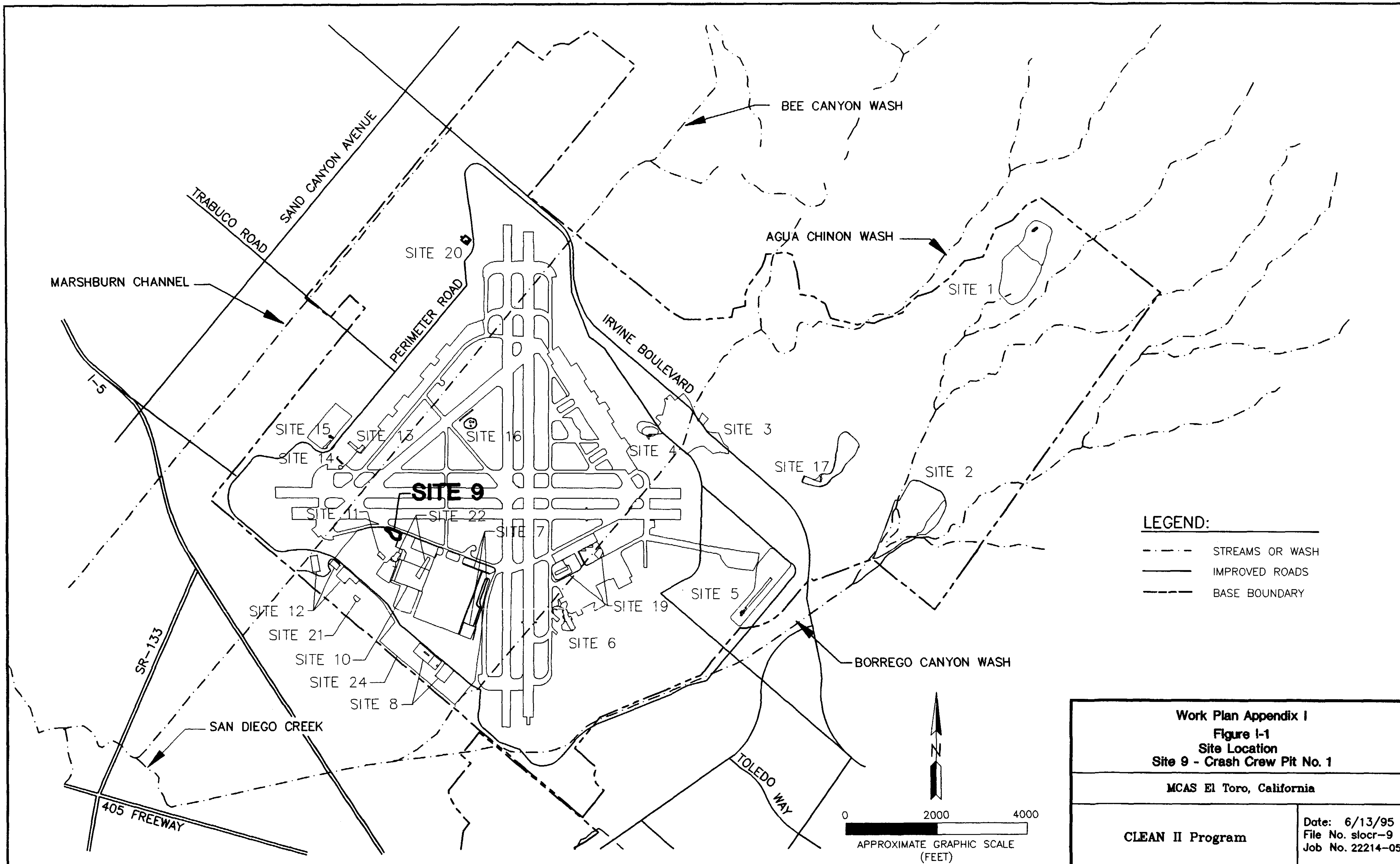
PHASE I REMEDIAL INVESTIGATION

For the Phase I RI, subareas within sites were designated as strata. Due to the fact that some new subareas have been added or subareas have been expanded or diminished for the Phase II RI/Feasibility Study (FS), subareas within sites will be referred to as units for the Phase II RI/FS. In this section, discussion is related to Phase I RI sampling and results, and the term strata will be used. Following this section, the term unit will be used.

For the Phase I RI, Site 9 was represented by one stratum, Stratum 1 (Pit Areas).

The following site-specific activities were conducted during the Phase I RI:

- four surface soil samples (0 to 6 inches below ground surface [bgs]) were collected from three locations;
- one 25-foot boring and 1 deep boring were drilled and sampled on-site. The deep boring was completed as a monitoring well (09_DBMW45);
- one downgradient monitoring well (09_DGMW75) was installed;



Work Plan Appendix I

Figure I-1
Site Location
Site 9 - Crash Crew Pit No. 1

MCAS El Toro, California

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Date: 6/13/95
File No. slocr-9
Job No. 22214-059

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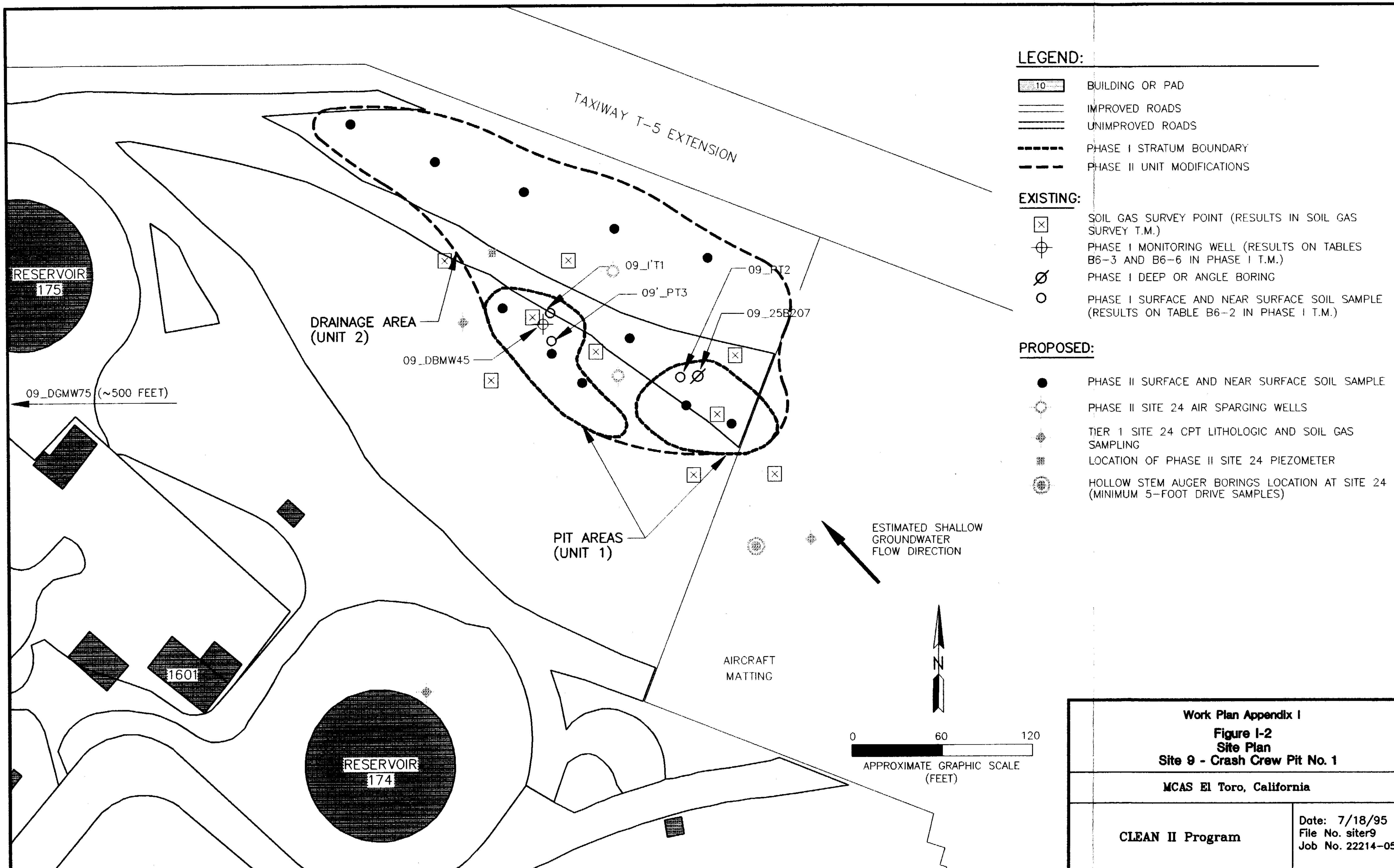

TAXIWAY T-5 EXTENSION
RESERVOIR 175
RESERVOIR 174
1601
DRAINAGE AREA (UNIT 2)
PIT AREAS (UNIT 1)
09_DGMW75 (~500 FEET)
09_DBMW45
09_I'T1
09'_PT3
09_PT2
09_25B207
ESTIMATED SHALLOW GROUNDWATER FLOW DIRECTION
AIRCRAFT MATTING
N
0
60
120
APPROXIMATE GRAPHIC SCALE (FEET)
LEGEND:
10
BUILDING OR PAD
IMPROVED ROADS
UNIMPROVED ROADS
PHASE I STRATUM BOUNDARY
PHASE II UNIT MODIFICATIONS
EXISTING:
SOIL GAS SURVEY POINT (RESULTS IN SOIL GAS SURVEY T.M.)
PHASE I MONITORING WELL (RESULTS ON TABLES B6-3 AND B6-6 IN PHASE I T.M.)
PHASE I DEEP OR ANGLE BORING
PHASE I SURFACE AND NEAR SURFACE SOIL SAMPLE (RESULTS ON TABLE B6-2 IN PHASE I T.M.)
PROPOSED:
PHASE II SURFACE AND NEAR SURFACE SOIL SAMPLE
PHASE II SITE 24 AIR SPARGING WELLS
TIER 1 SITE 24 CPT LITHOLOGIC AND SOIL GAS SAMPLING
LOCATION OF PHASE II SITE 24 PIEZOMETER
HOLLOW STEM AUGER BORINGS LOCATION AT SITE 24 (MINIMUM 5-FOOT DRIVE SAMPLES)
Work Plan Appendix I
Figure I-2
Site Plan
Site 9 - Crash Crew Pit No. 1
MCAS El Toro, California
CLEAN II Program
Date: 7/18/95
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Job No. 22214-059

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- nineteen subsurface soil samples were collected from the vadose zone during the drilling of the three borings;
- soil samples were analyzed for volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), total fuel hydrocarbons (TFH)-gasoline, TFH-diesel, total recoverable petroleum hydrocarbons (TRPH), dioxins, metals; and
- groundwater samples were analyzed for general chemistry, VOCs, SVOCs, TFH-gasoline, TFH-diesel, TRPH, metals, pesticides/polychlorinated biphenyls, and gross alpha and beta.

A summary of the ranges of analyte concentrations detected during the Phase I RI (sample identification of the highest concentration is provided), plus recent groundwater monitoring data are presented below. All chemicals of potential concern (COPCs) that were detected in soil are listed with the exception of specific metals, which are listed only if U.S. EPA Region IX Preliminary Remediation Goal (PRGs) or ecological screening criteria in shallow soil were exceeded. All COPCs that exceed PRGs or maximum concentration levels (MCLs) in groundwater are included in this list. If a minimum concentration is recorded with a "less than" symbol, it denotes a concentration below the contract laboratory program detection limit. Sample locations are shown on Figure I-2. A complete listing of all detected chemicals is presented in the Phase I RI Technical Memorandum, Appendix B-9, Tables B9-2 through B9-7, (Jacobs Engineering 1993b), and in the Groundwater Quality Data Report (Jacobs Engineering 1994a). Target analyte list (TAL) metals that were analyzed during the Phase I RI are beryllium, barium, arsenic, antimony, aluminum, cadmium, calcium, cobalt, copper, iron, lead, magnesium, manganese, mercury, nickel, potassium, selenium, silver, sodium, thallium, vanadium, and zinc.

Shallow Soil (less than 10 feet below ground surface)

- metals: barium (160 to 6,620 milligrams per kilogram [mg/kg] [09_DBW45 at 5 feet]), lead (4.7 to 62.5 mg/kg [09_PT2 at 0 feet]), and 19 other TAL metals;
- VOCs: 1,1,1-trichloroethane (< 10 to 9J micrograms per kilogram [µg/kg] [09_PT2 at 0 feet]), 2-butanone (< 11 to 3J µg/kg [09_PT3 at 0 feet]), acetone (< 11 to 25 µg/kg [09_25B207 at 5 feet]), carbon tetrachloride (< 10 to 3J µg/kg [09_PT3 at 0 feet]), toluene (< 10 to 4J µg/kg[09_DBMW45 at 5 feet]);
- SVOCs: dimethyl phthalate (< 680 to 360J µg/kg [09_PT2 at 0 feet]); and
- fuel and petroleum hydrocarbons: TFH-diesel (< 12.9 to 51.1 mg/kg [09_PT1 at 0 feet]), TFH-gasoline (< 0.054 to 0.89 mg/kg [09_PT2 at 0 feet]), TRPH (< 20 to 259 mg/kg [09_PT2 at 0 feet]).

Subsurface Soil (greater than 10 feet below ground surface)

- metals: barium (77 to 333 mg/kg [09_25B207 at 5 feet]), lead (1.2 to 10.5 mg/kg [09_DBMW45 at 10 feet), and 18 other TAL metals;

- VOCs: acetone (< 11 to 48 μg/kg [09_25B207 at 20 feet]), toluene (< < 11 to 6J μg/kg [09_DBMW45 at 55 feet]);
- SVOCs: benzyl butyl phthalate (< 700 to 270J μg/kg [09_DBMW45 at 95 feet]), bis(2-ethylhexyl) phthalate (< 710 to 6,500 μg/kg [09_25B207 at 10 feet]); and
- fuel and petroleum hydrocarbons: TFH-gasoline (< 0.054 to 0.55 mg/kg [09_25B207 at 25 feet]), TRPH (< 20 to 49 mg/kg [09_DGMW75 at 60 feet]).

Groundwater (09_DBMW45 on-site)

- general chemistry: nitrate/nitrite-N (17 to 19.1 milligrams per liter [mg/L]), total dissolved solids (TDS) (1.040 to 1,090 mg/L);
- metals: antimony (< 12.1 to 11.5B micrograms per liter [μg/L]), selenium (< 20.2 to 19.6 μg/L), and 10 other TAL metals;
- VOCs: 1,1-dichloroethene (< 1 to 4 μg/L), 1,2-dichloroethane (< 1 to 0.5J μg/L), carbon tetrachloride (3 to 7 μg/L), chloroform (2 to 3 μg/L), tetrachloroethene (5 to 8 μg/L), trichloroethylene (1,000D to 2,000D μg/L);
- fuel and petroleum hydrocarbons: TFH-gasoline (85 to 346J μg /L); and
- gross alpha and beta: gross alpha (8.3 to 9.6 picocuries per liter [pCi/L]), gross beta (9.9 to 11.2 pci/L).

Groundwater (09_DGMW75 downgradient)

- general chemistry: chloride (273 to 279 mg/L), nitrate as N (21.4 to 23.6 mg/L), sulfate (412 to 423 mg/L), TDS (1,370 to 1,470 mg/L);
- metals: antimony (< 17.6 to 14.6B μg/L), selenium (41.8 to 44.3 micrograms per liter [μg/L]), and 13 other TAL metals;
- VOCs: 1,1-dichloroethene (< 1 to 0.5J μg/L), carbon tetrachloride (1 to 2 μg/L), chloroform (0.9J* μg/L), methyl chloride (< 2 to 0.6J μg/L), tetrachloroethene (5 to 8 μg/L), trichloroethylene (270D to 280D μg/L); and
- fuel and petroleum hydrocarbons: TFH-gasoline (< 50 to 64.3J μg /L).

* = Indicates concentration repeated for two sampling events.

J = Indicates an estimated value for qualitative use only (organic parameters).

B = Indicates reported value is less than the contract-required detection limit (CRDL), but greater than the or equal to the instrument detection limit (IDL) (inorganic parameters).

D = The value for this compound is from a diluted analysis.

PRGs and ecological screening criteria for shallow soil were compared with corresponding shallow soil sample analytical results from Site 9. The results of this comparison are listed below (Jacobs Engineering 1993a, page A9-7):

- No COPCs exceed PRGs, and
- barium and lead concentrations exceed ecological screening criteria.

Based on California Leaking Underground Fuel Tank (LUFT) guidelines (LUFT 1989), petroleum hydrocarbons detected in Site 9 do not appear to pose a threat to groundwater.

Groundwater samples were collected from the two groundwater monitoring wells (09_DBMW45 and 09_DGMW75) constructed on-site and downgradient of Site 9. COPCs detected in groundwater samples were compared to PRGs and MCLs (Jacobs Engineering 1993a, page A9-7, Table A9-3b):

- 1,1-dichloroethene, 1,2-dichloroethane, carbon tetrachloride, tetrachloroethylene, trichloroethylene and nitrate exceed human health PRGs, and 1,1-dichloroethene, 1,2-dichloroethane, carbon tetrachloride, tetrachloroethylene, trichloroethylene, nitrate, and TDS exceed MCLs in the on-site well 09_DBMW45; and
- 1,1-dichloroethene, carbon tetrachloride, nitrate, tetrachloroethylene, and trichloroethylene, exceed PRGs, and antimony, carbon tetrachloride, chloride, nitrate, selenium, and sulfate, tetrachloroethylene, and trichloroethylene, and TDS exceed MCLs in downgradient well 09_DGMW75.

For the Phase II RI/FS, 09_DBMW45 will be sampled for total petroleum hydrocarbons (TPH)-gasoline and -diesel as part of the Site 24 VOC Source Investigation.

U.S. EPA AERIAL PHOTOGRAPH SURVEY

The U.S. EPA Aerial Photo Survey performed for the MCAS El Toro identified both the east and west pits on Site 9. Interpretation of the 1965 and 1970 photographs revealed staining and liquid that appears to flow from the northern and western edges of both of the pits on site (Jacobs Engineering 1993a).

SCIENCE APPLICATIONS INTERNATIONAL CORPORATION AERIAL PHOTOGRAPH SURVEY

The Science Applications International Corporation Survey identified extensive staining in the area of Site 9. The photos from both 1967 and 1968 verify the locations of the two pits identified in the U.S. EPA photographs. On the 1984 photograph, a stained area was observed north of the two pits and south of the taxiway (SAIC 1993).

EMPLOYEE INTERVIEWS

Vish Parpiana (from MCAS EL Toro) indicated during a conference call meeting on 15 November 1994, that no storage tanks holding combustible liquids were located around the crash crew pits area at Site 9. Liquids used for combustion in the pits were delivered by tanker trucks due to safety concerns over possible fire and explosion potential (Jacobs Engineering 1994b).

SOIL GAS SURVEY

In 1994, a soil gas survey was conducted for Sites 24 and 25 in the southwest quadrant of the MCAS El Toro. The sources of the regional VOC groundwater plume are believed to be located in this area of the Station. During this investigation both soil gas and soil samples were collected from approximately 15 and 30 feet bgs in 465 locations. Soil gas samples were analyzed for VOCs, TFH (gasoline and diesel), and benzene, toluene, ethylbenzene, and xylenes, while the soil samples were analyzed for VOCs.

During this investigation approximately nine sampling locations were positioned within or adjacent to the Site 9 boundaries. The results of soil gas samples collected from these locations indicated the presence of cis-1,2-dichloroethane, trans-1,2-dichloroethane, and 1,1-dichloroethane. No other compounds were identified in samples from these locations. The VOCs detected within the Site 9 boundaries will be investigated and evaluated as part of the Site 24, the VOC source investigation (Jacobs Engineering 1994a).

Geology

The geology of Site 9 consists of Quaternary alluvial and marine deposits (Jacobs Engineering 1993b). Holocene deposits consist of a matrix of fined-grained overbank deposits and some coarse-grained stream channel deposits. These soils are derived from the Santa Ana Mountains to the east and conformably overlie Pleistocene interbedded fine grained lagoonal and near-shore marine deposits. Pleistocene deposits could not be differentiated from Holocene deposits in Phase I RI soil borings. Pleistocene deposits unconformably overlie semiconsolidated marine sandstones, siltstones, and conglomerates of late Miocene to late Pliocene, which are considered to be bedrock in the area.

Based on a review of the Phase I RI boring logs, the subsurface lithology at Site 9 consists of well graded to silty sand that is interbedded with silt and clay. Within the sand units are occasional gravel lenses, that are probably associated with stream channel deposits.

Hydrogeology

MCAS El Toro lies within the Irvine Groundwater Basin, a subbasin of the Los Angeles groundwater basin. Regional aquifers in the Irvine Subbasin tend to be composed of discontinuous lenses of clayey and silty sands and fine grained gravels contained within a complex assemblage of sandy clays and sandy silts. Three general aquifer systems have been identified near the Station: a shallow and perched system, a principal aquifer zone, and a lower hydrogeologic system existing in bedrock (Jacobs Engineering 1993b).

The Phase I RI results indicate that the shallow, perched zone is not present at Site 9. The principal aquifer is the main water-producing zone for the Irvine area and is of primary interest in this investigation. The principal aquifer is encountered about 120 feet beneath Site 9. The regional groundwater flow direction in the area of the site is generally to the northwest. The hydraulic gradient in the area of the site has been influenced strongly by the pumping of irrigation wells located west of MCAS El Toro.

Conceptual Site Model

In the process of developing a conceptual site model, release mechanisms and potential sources of contamination were considered and evaluated to determine their applicability to the site. Also considered in the development of the conceptual site model were potential receptors and contaminant pathways to potential receptors. Figure I-3 illustrates the conceptual site model developed for the site. Figure I-4 depicts the potential exposure routes and pathways for human and ecological receptors.

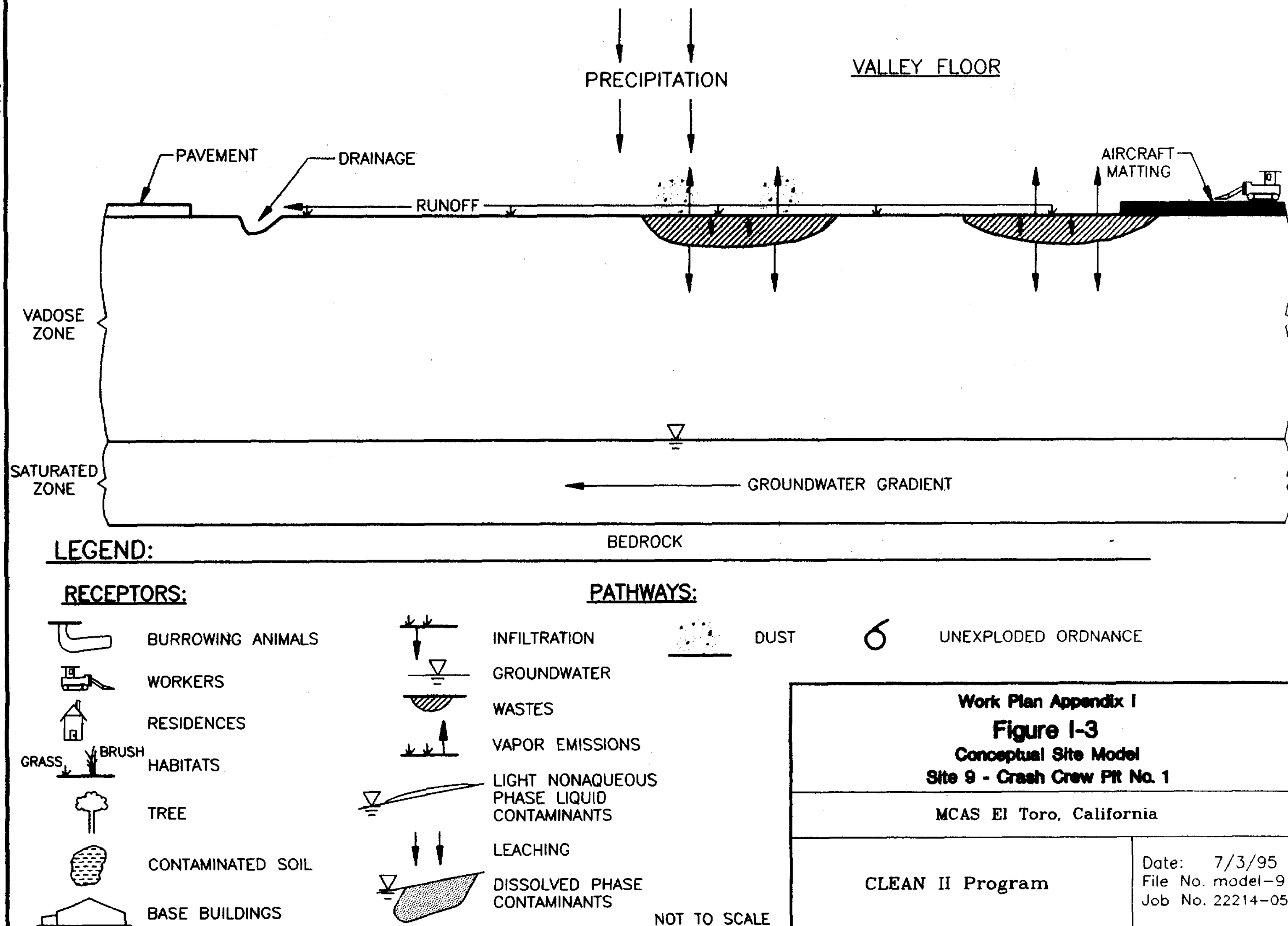
The primary release mechanism is contaminants released to shallow soil from disposal activities at this site. Eventually under gravity, contaminants present in shallow soil may move downward with soil moisture (in dissolved phase) or in a liquid phase. The depth of groundwater is recorded to be about 120 feet bgs.

The secondary source of contaminants is the surrounding soil impacted by disposal activities. One secondary release mechanism is the dust brought into suspension in the air by wind. The fine particles of dust may contain all potential contaminants. Storm water runoff may form another secondary release mechanism. Storm water carries contaminants in dissolved forms, colloidal forms, or associated with suspended soil particles.

The potential pathways are air, groundwater, and surface water. Airborne contaminants are transported through fugitive dust and volatilization. The transport through air is affected by wind speed and direction, type of contaminant, and weather conditions. Typical wind condition at MCAS El Toro is from west/southwest at less than 10 knots. Transportation of airborne contaminants through volatilization is expected to be unimportant at this site. Surface water transport is affected by the amount of rainfall, type of contaminant, surface soil properties and the topography of the area. The mean annual rainfall at MCAS El Toro is about 14.0 inches, most of it occurs from November through April.

Current and/or potential receptors of chemicals at this site via inhalation are workers and visitors involved in disposal activities. Direct contact with surface and subsurface soils is currently possible via dermal or ingestion exposures of workers. Infiltration of contaminated water through the vadose zone into groundwater is possible because subsurface soil is mainly sands, with some silts and clays. However, current exposure of workers of groundwater at this site.

Terrestrial wildlife could be exposed to chemicals in on-site surface soil, and dust and vapors through ingestion, dermal absorption or inhalation. Terrestrial plants could also be exposed through root absorption of chemicals in surface soil or deposition of dusts. No special-status species were observed at this site, and the immediate area provides marginal habitat for wildlife species.



Work Plan Appendix I

Figure I-3

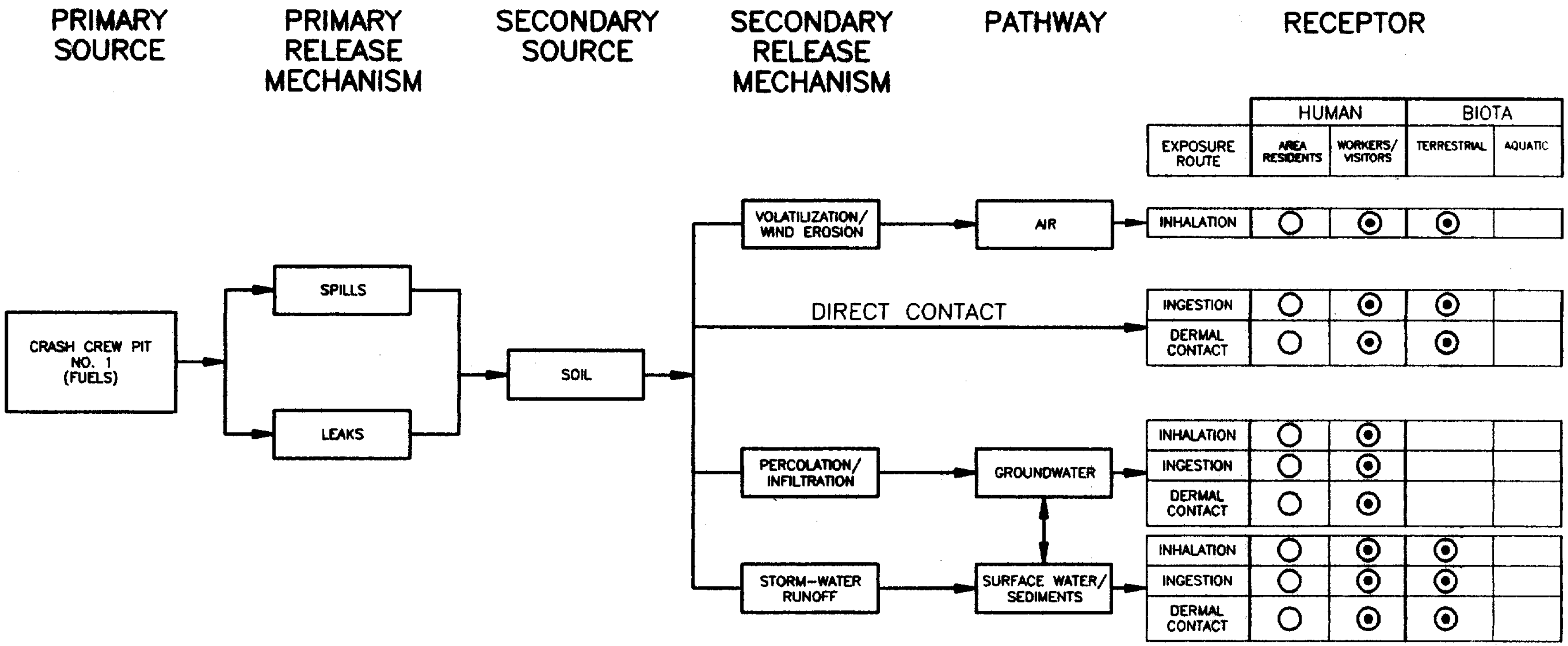
Conceptual Site Model

Site 9 - Crash Crew Pit No. 1

MCAS El Toro, California

CLEAN II Program

Date: 7/3/95
File No. model-9
Job No. 22214-059



LEGEND:

● CURRENT POTENTIAL RECEPTOR

○ FUTURE POTENTIAL RECEPTOR

Work Plan Appendix I

Figure I-4

Exposure Routes and Receptors
Site 9 - Crash Crew Pit No. 1

MCAS El Toro, California

CLEAN II Program

Date: 6/28/95
File No. mod9
Job No. 22214-059

Statement of Phase II RI/FS Problem

Site 9, Crash Crew Pit No. 1, is located in the western portion of the MCAS El Toro, to the northeast of Building 306, and just south of a taxiway for the east/west runway (Figure I-1). The site consists of two pits (east and west) that were utilized to train firefighters. The problems associated with this site are the following:

- shallow soil at Site 9 may be contaminated with VOCs, SVOCs, petroleum hydrocarbons, and possibly metals;
- soil sample analytical data do not suggest that site activities have impacted groundwater;
- however, the VOC groundwater plume hot spot is located beneath Site 9; and
- more data is necessary to calculate a cumulative excess cancer risk and hazard index for the site.

STEP 2 – IDENTIFY THE DECISION

This step describes the decisions that will be considered during the DQO process for Site 9. For each decision, the alternative outcomes are stated. The Sampling Decision Process is illustrated on Figure I-5. For Site 9, the following decisions will be considered:

1. Do COPCs in shallow soil (less than 10 feet bgs) in the unit exceed established background concentrations and PRGs, and/or do they present an unacceptable risk to human health or the environment?

   If yes, proceed to the next decision.

   If uncertain, collect additional soil samples to determine risk.

   If no, recommend the unit for No Further Investigation (NFI).

2. Has the extent of impacted soil been defined in the shallow soil?

   If yes, evaluate a response action.

   If no, conduct soil sampling to define extent.

3. Does the extent of impacted shallow soil extend into the subsurface (greater than 10 feet bgs)?

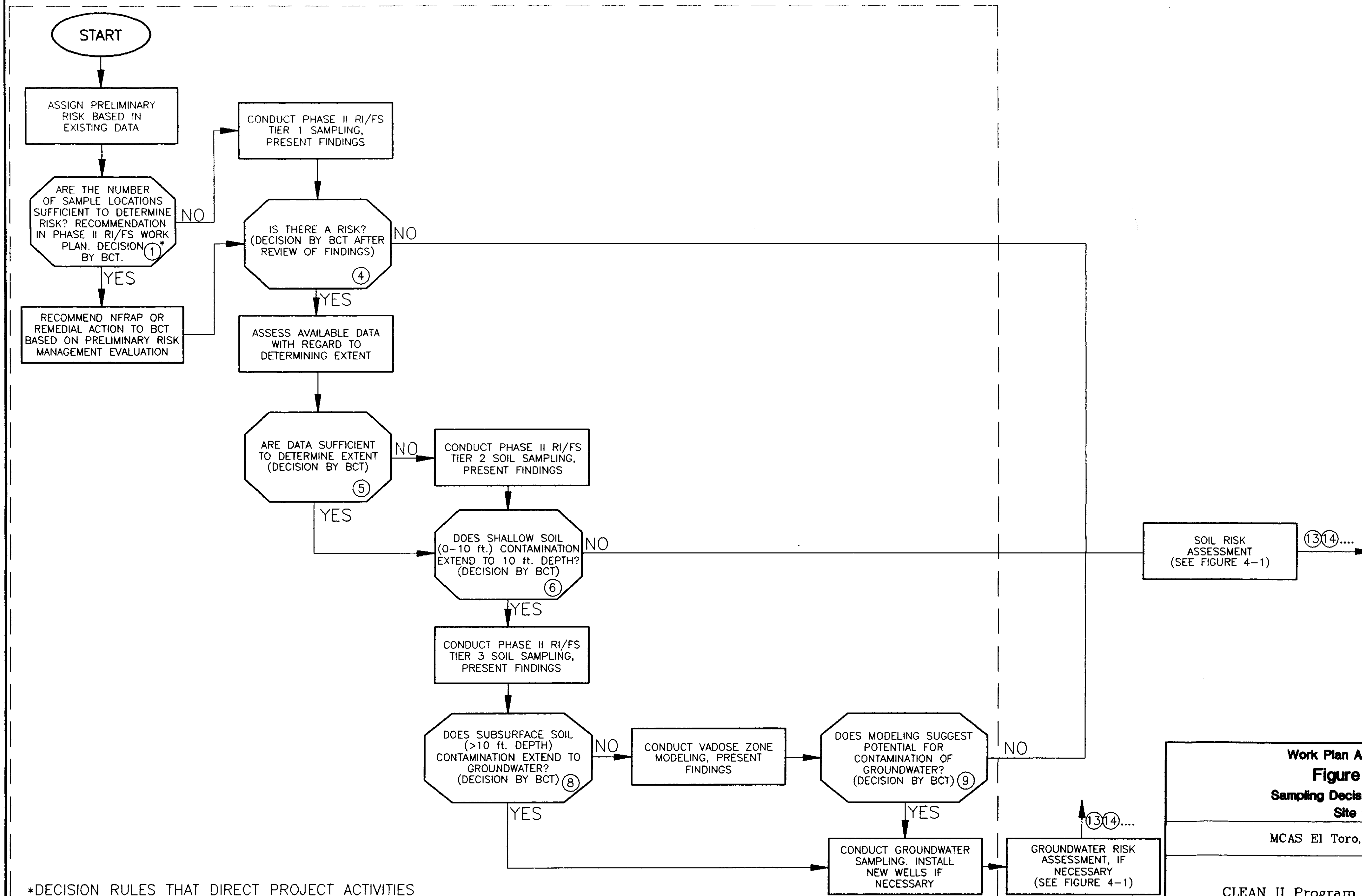
   If yes, conduct soil sampling to define vertical extent of impacted soil, and if necessary, evaluate potential impacts to groundwater beneath the site.

   If no, evaluate a response action.

4. Do the media being evaluated for a response action qualify for Early Action?

   If yes, recommend unit for an Engineering Evaluation/Cost Analysis (EE/CA).

   If no, recommend unit for a remedial response as part of the RI/FS process.



Work Plan Appendix I

Figure I-5

Sampling Decision Process

Site 9

MCAS El Toro, California

CLEAN II Program

Date: 3/11/95
File No. Logicr9
Job No. 22214-059

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STEP 3 – IDENTIFY THE INPUT AFFECTING THE DECISION

Step 2 defined the decisions addressing possible actions at the site. Step 3 will identify the inputs that are required to assess the actions as discussed below.

Inputs for No Further Investigation

Input information required to support a NFI recommendation will also be used to support decisions for Early Action and Long-Term Action. These inputs are as follows:

- list of COPCs;
- definition of the extent of impacted soil;
- background concentrations for metals, pesticides, and herbicides;
- determination of risk for the unit; and
- action levels for the protection of human health and the environment.

Inputs for Early Action

In addition to the inputs required for a NFI recommendation, input information required to support a Early Action recommendation will include the following:

- applicable or relevant and appropriate requirements (ARARs);
- identification of cleanup standards;
- identification of cleanup technology applicability/limitations that are not extensive operation and maintenance activities; and
- site/unit cleanup in less than 5 years.

Inputs for Long-Term Action

In addition to the inputs required for a NFI recommendation, input information required to support a Long-Term Action recommendation may include the following:

- ARARs;
- identification of cleanup standards;
- identification of cleanup technology applicability/limitations;
- pilot testing of remedial alternatives; and
- site/unit cleanup in more than 5 years.

Descriptions of Inputs

The following subsections discuss the inputs required to assess possible response actions.

CHEMICALS OF POTENTIAL CONCERN

The COPCs for Site 9 include all chemicals detected in the Phase I RI for each medium (Jacobs Engineering 1993a, pages A9-3 to A9-5). COPCs for Site 9 are listed below.

Shallow Soil

- metals: aluminum, arsenic, barium, beryllium, cadmium, cobalt, copper, lead, manganese, nickel, selenium, silver, thallium, vanadium, zinc;
- VOCs: 1,1,1-trichloroethane, 2-butanone, carbon tetrachloride, toluene;
- SVOCs: dimethyl phthalate; and
- fuel and petroleum hydrocarbons: TRPH, TFH-gasoline, TFH-diesel.

Subsurface Soil

- metals: aluminum, arsenic, barium, beryllium, cadmium, cobalt, copper, lead, manganese, nickel, selenium, silver, thallium, vanadium, zinc;
- VOCs: 1,1,1-trichloroethane, 2-butanone, acetone, carbon tetrachloride, toluene;
- SVOCs: benzyl butyl phthalate, bis(2-ethylhexyl) phthalate, dimethyl phthalate; and
- fuel and petroleum hydrocarbons: TRPH, TFH-gasoline, TFH-diesel.

Groundwater – On-Site

- metals: aluminum, antimony, barium, manganese, nickel, selenium, vanadium;
- VOCs: 1,1-dichloroethane, 1,2-dichloroethane, carbon tetrachloride, chloroform, tetrachloroethene, trichloroethylene;
- fuel and petroleum hydrocarbons: TRPH, TFH-gasoline, TFH-diesel; and
- gross alpha and beta: gross alpha and gross beta.

Groundwater – Downgradient

- metals: aluminum, antimony, arsenic, barium, chromium, manganese, mercury, nickel, selenium, vanadium, zinc;
- VOCs: 1,1-dichloroethene, carbon tetrachloride, chloroform, methyl chloride, tetrachloroethene, trichloroethylene; and
- fuel and petroleum hydrocarbons: TFH-gasoline.

THE NATURE AND EXTENT OF CONTAMINATION

Phase II RI/FS sample locations, depths, and chemical analyses have been designed to assess the risk associated with the site. Additional sampling will be conducted if it is necessary to further define the extent of impacted shallow soil, subsurface soil, or groundwater.

BACKGROUND CONCENTRATIONS

The background concentrations for metals, herbicides, and pesticides are presented in Section 4 of the Phase II RI/FS Work Plan.

DETERMINATION OF RISK

A determination of the human health risk associated with each site is based on a baseline or streamline risk assessment. Baseline risk assessments are performed on RI/FS sites. The objective of a baseline risk assessment is to estimate the risks associated with the no action alternative and thereby provide decision makers information useful in identifying the most appropriate remedial action alternative. The risk estimates produced also serve as a benchmark to which reductions in risk achieved by remedial actions may be compared. Streamlined risk assessments are performed on removal action sites to support the removal action.

In addition to the human health risk assessment conducted for a site, an ecological risk assessment may also be performed. The ecological risk assessment will evaluate current and potential risks to the environment posed by the chemical releases that have occurred at the sites.

IDENTIFICATION OF CLEANUP LEVELS

Cleanup levels will be based on ARARs, background concentrations, and risk levels that will be determined for the site.

CLEANUP TECHNOLOGY EFFECTIVENESS, IMPLEMENTABILITY, AND COSTS

Once cleanup levels have been established, the most appropriate and cost effective approach will be identified to remediate the site, if necessary.

STEP 4 – DEFINE THE BOUNDARIES OF THE STUDY

This step defines the spatial and temporal boundaries of the problem and any practical constraints that may interfere with the study:

- Unit 1 – The Pit Areas, which cover approximately 10,100 feet^2 and have the same boundaries as Phase I RI, Site 9, Stratum 1.
- Unit 2 – The Drainage Ditch, which covers approximately 40,100 feet^2 and includes the drainage area from the crash crew pits to the catch basin. Unit 2 was created for the Phase II RI/FS to investigate the drainage area adjacent to the crash crew pits.

Specification of temporal boundaries for the field sampling activities is unnecessary. Shallow and deeper subsurface soil conditions are not considered to be significantly different from conditions during the Phase I RI sampling or throughout the period since spillage or unregulated waste disposal activities occurred on the site.

STEP 5 – DEVELOP A DECISION RULE

Decision rules are required to state explicitly the types of inputs and logical basis for choosing among alternative actions during the Phase II RI/FS. A list of all decision rules for the project are included in Section 4 of the Work Plan. The specific decision rules that will be followed to determine an action are presented here. These decision rules conform to the numbering sequence presented in Section 4 of the Work Plan.

2. If Phase I data are sufficient to assess a response action to reduce risk associated with site units that exceed media action levels or background concentrations, then the cleanup levels and appropriate response action (Early Action or Long-Term Action) will be determined.

3. If Phase I data are not sufficient to assess whether risks are present based on the minimum number of samples, then Tier 1 sampling of the Phase II RI/FS will be completed to supplement the Phase I analytical results so the minimum number of samples is satisfied to assess whether action levels or background concentrations are exceeded in site units.

4. If Phase I data and Tier I data for the Phase II RI/FS indicate that no solid wastes are exposed and respective action levels or background concentrations for the various media of a site unit are not exceeded, then NFI will be recommended.

5. If Phase I data or Tier 1 data of the Phase II RI/FS combined with Phase I data exceed PRGs, action levels, or background concentrations for the various media, then Tier 2 of the Phase II RI/FS sampling and analyses will be conducted to define horizontal and vertical extent, provided additional sampling costs are not more than a potential response action.

6. If PRGs, action levels, or background concentrations for shallow soil are exceeded, and if COPCs detected in the soil extend to 10 feet bgs, then soil below 10 feet bgs (subsurface soil) will be investigated to assess the horizontal and vertical extent of the COPCs.

7. If during the investigation of COPCs in subsurface soil, two consecutive soil sample analyses (at a minimum 5-foot-depth separation) demonstrate that COPCs are not detected, then the vertical extent of soil contamination will be established and investigation of subsurface soil will be halted at that location. The horizontal extent will be established when COPCs are not detected in vertical samples taken at three locations around the sample that exceeds the action levels.

   The lowest detection limit available will be used to define the base of a contaminant plume. COPC detection or quantitation limits that will be compared to establish the base of the contaminant plume include the following:

   - CRDL,
   - contract-required quantitation limit,
   - sample quantitation limit,

- estimated quantitation limit,
- practical quantitation limit,
- method detection limit, and
- IDL.

8. If during the investigation of COPCs in subsurface soil, it is determined by actual sampling that COPCs extend to the water table, groundwater beneath the site will be investigated for the presence of the COPCs.

9. If COPCs are identified in subsurface soil below 10 feet bgs, above background and action levels, but do not extend to the water table, then vadose zone computer modeling will be used to evaluate the potential for the COPCs to impact groundwater.

10. If it is determined that COPCs in subsurface soil have impacted groundwater causing exceedance of action levels, then the vertical and horizontal extent of groundwater exceedance will be evaluated.

13. If action levels or background concentrations are exceeded for the media of a site unit, then the risk assessment will be initiated, based on sample results, acceptable levels of risk, and potential land uses, to assess potential risks to human health and/or the environment.

14. If unacceptable risks are assessed to human health or the environment, then cleanup levels will be evaluated for each media.

15. If cleanup levels in a given medium are exceeded, and if the site meets at least one of the eight criteria for removal action described in 40 *Code of Federal Regulations* (CFR) 300.415(b)(2), and the scale and complexity of contaminant distribution in the affected medium are such that excess risk can be expediently reduced utilizing readily available technology, then the medium at the site will be recommended for Early Action.

16. If an early removal action is selected, a non-time-critical EE/CA and Action Memorandum will be completed for the removal action.

17. Once the removal action is completed, the site will be evaluated for residual risk. If a residual risk exists, then a Long-Term Action may be required.

18. If cleanup levels for a given medium are exceeded, and if the site does not meet criteria for an Early Action, then the affected medium will be recommended for long-term remedial action as part of the RI/FS process; and an FS will be completed, followed by a Record of Decision, Remedial Design, and remedial action to clean up the site for closure.

STEP 6 – SPECIFY LIMITS ON UNCERTAINTY

The purpose of Step 6 is to specify the tolerance limits for decision errors, which are used by the decision makers to establish performance goals for the data collection design. The objective of the data collection design is to obtain data that reliably estimate the true nature of environmental conditions at Site 9. This process is presented in Section 4 of the Work Plan and the following presents specific information on Site 9.

Identify the Null Hypothesis and Specify the Decision Errors

The null hypothesis for this site specifies that the concentrations of one or more of the COPCs exceed PRGs or risk-based action levels and represent an unacceptable risk at the site.

The alternative hypothesis for this site specifies that the concentrations of one or more of COPCs do not exceed PRGs or risk-based actions levels and represent an acceptable risk at the site.

The false-positive and false-negative decision errors are discussed in Section 4 of the Work Plan.

Decision Error Limits

For the Phase II RI/FS, the allowable probability of making a false-positive decision has been designated as 0.05 (confidence of 95 percent) and an allowable probability of making a false-negative decision error has been designated as 0.20 (power of 80 percent).

Calculating the Number of Samples Necessary to Determine Risk

The number of sample locations necessary to determine the risk at a unit or a site were estimated using the process presented in Section 4 of the Work Plan. The number of additional sample locations needed to assess risk during the Phase II RI/FS is the difference between the total number of sample locations and the number of locations sampled during the Phase I RI (Table I-1).

Sampling Designs for the OU-3 Sites

Two types of sampling designs will be used to determine the soil conditions at Site 9. These two sampling designs are:

- stratified random sampling (either whole or partial unit areas, with replacement where sample locations are closely spaced or overlap), and
- systematic random sampling along an axis (with replacement if new and existing sample locations overlap or are closely spaced)

Descriptions of these Phase II RI/FS sampling designs are presented in Section 4 of the Work Plan. The two sampling designs utilize random positioning to produce an unbiased configuration of sample locations. The advantage of a random, unbiased sampling design is that the tolerance limits for false-positive and false-negative decision errors can be applied to the sample data and the risk decisions can be assigned a level of confidence.

Table I-1
Summary of Phase II RI/FS OU-3 Soil Sampling Strategies

Description	Unit Area	Estimated Risk[a]	Number of Locations/ Samples[b]	Number of Phase I Locations/ Samples	Number of Phase II Locations/ Samples	Tier	Type of Sampling Strategy
Site 9–Crash Crew Pit No. 1:	Unit 1–10,100 ft^2	$< 10^{-6}$ (0.39)	14(42)	5 (7)	5(15)[c]	1	Stratified Random
	Unit 2–40,100 ft^2	UNK	12(36)	0	6(18)[c]	1	Systematic Random on an Axis

Notes:

[a] These estimated cumulative cancer risk values were developed using Phase I RI data, and COPC-specific risk-based concentrations were developed following completion of Phase I RI activities. Numbers in parentheses are the estimated hazard index values.

[b] Number of samples based on comparison of estimated cancer risk to Table 4-7 in Phase II RI/FS Work Plan, which correlates four cancer-risk categories to the number of samples needed to determine that risk using the project-specific power and confidence limits. For this column, the first number represents sample locations, and the second number (in parentheses) is the number of samples based on an average of three depth intervals per sample location.

[c] These numbers represent the difference between the number of samples required to determine risk and the number of samples collected as part of the Phase I RI, with the following provisions:
Where Phase II RI/FS sample locations were recommended to determine risk, the area covered by this number of locations was based upon the U.S. EPA risk determination standard of a 40- x 40-meter block per sample location. This corresponds to an area of about 206,700 $feet^2$ for 12 sample locations. If the unit area is greater than this size limit, the maximum specified number of samples, less the Phase I RI number of samples, will be collected during the Phase II RI/FS. If the unit area is less than this size limit, the number of sample locations represents a ratio of the unit area versus the 12-sample area (206,700 $feet^2$) times 12 (e.g., Site 19, Unit 3: [Unit 3 area/206,700 $feet^2$]) x 2 locations = 9 locations needed - 3 Phase I locations = 6 new Phase II RI/FS locations required. Use of this ratio rule should maintain the necessary power and confidence limits at units where fewer samples are collected. At units where the ratio rule is applied, the total number of samples (Phase I and Phase II combined) will never be less than six despite the ratio calculation, to be sure that the minimum number of sample locations necessary for a risk assessment is collected. The number of Phase II RI/FS shallow soil boring locations has been based on three samples per location. However, at Site 8 (Unit 3) and Site 12 (Units 1, 2, and 4), four samples per location will be collected.

STEP 7 – OPTIMIZE THE DESIGN

Historic site activities, previous site investigation results, and regulatory comments were used to formulate the Phase II RI/FS sampling approach. Shallow and deeper subsurface soils will be investigated at this site using a tiered sampling approach. This sampling approach consists of three tiers:

- The main focus of the Tier 1 sampling plan will be to determine whether the unit is a risk. The Tier 1 sampling approach will consist of collecting of shallow soil samples (less than 10 feet bgs) from a specific number of sampling locations within the unit. The number of sampling locations has been proposed, such that when the Phase I and II RI/FS data are evaluated together, an assessment of risk can be completed for the unit.
- The Tier 2 sampling approach will also focus on shallow soil; however, the primary objective will be to refine the extent of shallow soil that has been impacted by site activities, by focusing on subareas of the unit where COPCs PRGs as identified by the Tier 1 sampling and/or Phase I RI/FS results.
- The Tier 3 sampling approach has been designed to estimate the horizontal and vertical extent of impacted subsurface soil (greater than 10 feet bgs). This sampling strategy will only be implemented if Phase I RI/FS soil sample analytical data or Phase II RI/FS Tier 1/Tier 2 soil sample analytical data suggest impacted soil exists at depths greater than 10 feet bgs. Groundwater will be investigated if Phase I or Phase II soil data indicate potential impacts to groundwater are possible.

The tiered sampling approach is detailed in the following sections and in the Phase II RI/FS Field Sampling Plan, Attachment I (BNI 1995). For a list of all soil sampling and analysis at Site 9 see Table I-2.

Tier 1

The Tier 1 of sampling will be collection of shallow samples from each unit within the site as described below.

TIER 1 SOIL SAMPLING

Tier 1 sample locations in both the units will be positioned either by systematic random sampling locations on an axis or stratified random sampling locations to characterize additional areas not sampled as part of the Phase I RI/FS (Figure I-2).

Unit 1: The Pit Areas

The objectives of this investigation are to collect sufficient data to confirm possible removal action recommendation and support risk assessment.

Table I-2
Soil Sampling and Analysis

Tier	Unit/Name	PHASE II RI/FS SAMPLE NUMBERS			FIELD[a] - IMMUNOASSAY OR MOBILE LABORATORY					OFF-SITE LABORATORY[b]		
		No. of Locations	Samples/ Location	Total Samples	PAH[c]	PCBs[c]	VOCs[c]	TPH Gas and Diesel[d]	Target Analyte List - Metals[d]	PCBs and Pesticides	Herbicides	Others
Tier 1	Unit 1 Pit Areas	5	3	15	X		X	X	X			X
	Unit 2 Drainage Areas	6	3	18	X		X	X	X			X
	Tier 1 Subtotals			33	33		33	33	33			33
Tier 2	Optional: Scope of Tier 2 would be to further define extent of shallow soil contamination; based on Tier 1 data, Phase I RI findings, and soil gas survey results, with approval of BCT											
Tier 3	Optional: Scope of Tier 3 would be to characterize horizontal and vertical extent of contamination below 10 feet depth; based on Tier 1 and 2 data, Phase I RI findings, and soil gas survey results, with approval of BCT											

Notes:
[a] three samples from Unit 1 and nine samples from Unit 2 will go to the off-site laboratory for confirmation analyses
[b] these constituents cannot be determined in the field; all samples to be analyzed for these constituents will be sent to the off-site laboratory
[c] immunoassay analyses
[d] mobile laboratory analyses

During the Phase I RI, five locations were sampled in the area of Unit 1. The results of this investigation indicated that no COPCs detected in the shallow soil exceeded PRGs; however, barium and lead concentrations in soil exceeded ecological screening criteria. Soil samples were analyzed for VOCs, SVOCs, TFH-diesel and -gasoline, TRPH, and metals. In addition, one soil sample at a depth of 20 feet bgs was analyzed for dioxins and dibenzofurans; however, none were detected.

In the Phase II RI/FS, Tier 1 soil samples will be collected at 0, 5, and 10 feet bgs at five stratified random sampling locations. All soil samples will be field screened for polynuclear aromatic hydrocarbons (PAH) with immunoassay kits (U.S. EPA Method 4035), for VOCs (U.S. EPA Method 8010), TPH (U.S. EPA Method 8015M), and TAL metals (U.S. EPA Method 6000/7000) using a mobile laboratory. All soil samples will be analyzed by a fixed-base laboratory for analysis of dioxins/dibenzofurans (U.S. EPA Method 8280) under Naval Facilities Engineering Services Center (NFESC; formerly known as NEESA) Level D protocols. For quality assurance/quality control (QA/QC) support and verification, three samples (two detects and one nondetect) will be submitted to the fixed-base laboratory to confirm field screening results. These fixed-base analyses are PAH (U.S. EPA Method 8310), VOCs (U.S. EPA Method 8010), TPH (U.S. EPA Method 8015M), and TAL metals (U.S. EPA Method 6000/7000) under NFESC Level D protocols. Attachment I in the FSP provides the sampling procedures for the Phase II RI/FS at Site 9, Unit 1 (BNI 1995).

Unit 2: Drainage Ditch

The objectives of this investigation are to collect sufficient data to characterize and determine the extent of contamination, confirm possible NFI recommendation per Unit 1 and support risk assessment.

The area of Unit 2 was not investigated during the Phase I RI. In the Phase II RI/FS, Tier 1 soil samples will be collected at 0, 5, and 10 feet bgs at six systematic random sample locations based on an axis. All soil samples will be field screened for PAH with immunoassay kits (U.S. EPA Method 4035), VOCs (U.S. EPA Method 8010), TPH (U.S. EPA Method 8015M), and TAL metals (U.S. EPA Method 6000/7000) using a mobile laboratory. All soil samples will be analyzed by a fixed-base laboratory for analysis of dioxins/dibenzofurans (U.S. EPA Method 8280) under NFESC Level D protocols. For QA/QC support and verification, nine samples (six detects and three nondetects) will be submitted to the fixed-base laboratory to confirm field screening results. These fixed-base analyses are PAH (U.S. EPA Method 8310), VOCs (U.S. EPA Method 8010), TFH (U.S. EPA Method 8015M), and TAL metals (U.S. EPA Method 6000/7000) under NEESA Level D protocols. Attachment I in the FSP provides the sampling procedures for the Phase II RI/FS at Site 9, Unit 2 (BNI 1995).

Tier 2

The primary objective of the Tier 2 sampling program is to refine the extent of impacted soil identified within each unit by Phase I and/or II RI/FS sampling results. The Tier 2 sampling program will focus exclusively on shallow soil (at 10-feet depth) conditions and will further investigate subareas within the unit boundary that exceed PRGs.

The Tier 2 sampling plan will be developed after an evaluation of Phase I RI/FS and/or Phase II RI Tier 1 analytical results. If a Tier 2 sampling program meets the DQO for this unit, the decision to proceed will be based upon the criteria described in DQO Steps 2, 3, and 5. The proposed Tier 2 sampling plan, with recommendations, will be reviewed by the Base Realignment and Closure (BRAC) Cleanup Team (BCT). The BCT will decide whether the proposed Tier 2 sampling program will be implemented by the Navy.

TIER 2 SOIL SAMPLING

As noted, the objective of a Tier 2 sampling program is to refine the extent of impacted shallow soil within the unit being investigated. The rationale for accomplishing this objective depends primarily on the size and layout of the unit. Where the unit is a linear feature such as a drainage ditch, the Tier 2 program will focus sampling along the trend of the ditch bracketing the Tier 1 sampling locations (or Phase I RI/FS sample locations) where analyte concentrations exceeding PRGs are reported.

For units of rectangular, roughly circular, or irregular dimensions, a systematic random sampling based on a grid, stratified random sampling, or judgmental sampling approach will be used to define the extent of the Tier 1 sample location(s) where analyte concentrations exceeded PRGs. The limits of the area covered by these sampling approaches will be contingent upon the distribution of adjacent Tier 1 sample locations in which the COPCs were not detected.

The number of Tier 2 sampling locations (i.e., grid spacing) will be selected to achieve the following objectives:

- provide the areal coverage necessary to define the extent of shallow impacted soil; and
- minimize the cost associated with field and fixed-base laboratory sample testing.

The spacing between sampling locations for Tier 2 will be contingent upon the estimated size of the area to be investigated, and the spacing between Phase I or II RI/FS sample locations. Tier 2 soil sample depth intervals and chemical analyses will conform to those specified for Tier 1 soil sampling.

Tier 3

The Tier 3 sampling program would only be implemented at a unit where Phase I RI data, or the initial evaluation of the Phase II RI Tier 1 and/or Tier 2 sampling program results suggest that soil contamination may extend to depths greater than 10 feet bgs.

The objectives of the Tier 3 sampling program are to estimate the horizontal and vertical extent of impacted subsurface soil (greater than 10 feet bgs) and assess whether groundwater beneath the site has been impacted by historic site activities. If impacted subsurface soil is limited to the vadose zone above the water table or vadose zone modeling does not suggest a potential for COPCs to impact groundwater, then groundwater quality will not be investigated.

The Tier 3 sampling plan will be developed after an evaluation of Phase I RI/FS and Phase II RI Tier 1 and/or 2 analytical results. If a Tier 3 sampling program meets the DQO for this unit, then the decision to proceed will be based upon the criteria described in DQO Steps 2, 3, and 5. The proposed Tier 3 sampling plan, with recommendations, will be reviewed by the BCT. The BCT will decide whether the proposed Tier 3 sampling program will be implemented.

Optimization of Sampling Plan

As soil analytical data becomes available from sampling in each unit, investigative plans for the site will be optimized. The proposed tiered sampling approach is an iterative process that will permit data from one tier to be evaluated prior to the implementation of the next tier of sampling. The iterative process involves review of data, recommendations for further actions, and approval of the BCT. In this way, the investigation can be optimized by performing the least amount of sampling necessary to assist the decision making process about future actions at the unit (i.e., NFI, Early Action, and Long-Term Action).

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WORK PLAN APPENDIX J

DATA QUALITY OBJECTIVES
OPERABLE UNIT 3 –
SITE 10 – PETROLEUM DISPOSAL AREA

SUMMARY

STEP 1 – STATE THE PROBLEM

Site 10, the Petroleum Disposal Area, consists of four areas: 1) a northern aircraft parking area covered by aircraft matting; 2) a southern aircraft parking area covered by concrete; 3) a vehicle parking lot south of the concrete aircraft apron; and 4) vehicle parking area on the northern side of Building 1589. From 1952 through 1970, an estimated 52,000 gallons of waste fluids (waste oil, antifreeze, transmission fluids, and solvents) were applied to these areas for dust control. During the 1970s, the two large sprayed areas were excavated and covered with concrete, or stabilized and covered with matting. Soil beneath Site 10 has been contaminated by previous waste-disposal activities at the site. Available information suggests that the contaminated soil may be limited to the shallow soil interval at depths of less than 10 feet below ground surface. The human health and ecological risks associated with the contaminated soil will be estimated so that a No Further Investigation, Removal Action, or the appropriate remedial alternative can be selected.

STEP 2 – IDENTIFY THE DECISION

The Phase II Remedial Investigation/Feasibility Study decisions to be considered at Site 10 are the following: Do chemicals of potential concern in shallow soil at Site 10 present an unacceptable risk to human health and the environment? Are the chemicals of potential concern present in the subsurface soil (greater than 10 feet below ground surface), and if so, do they present an unacceptable risk to groundwater? The possible decision outcomes are recommendations for No Further Investigation, Early Action, or Long-Term Action.

STEP 3 – IDENTIFY THE INPUTS AFFECTING THE DECISION

Inputs necessary to make these decisions include a list of chemicals of potential concern; the extent of impacted media; the background/ambient concentrations of metals, herbicides, and pesticides; and the action levels for protection of human health and the environment.

STEP 4 – DEFINE THE BOUNDARIES OF THE STUDY

The study is limited to the geographic area of Site 10, which comprises four subareas for the Phase II Remedial Investigation/Feasibility Study: 1) the aircraft matting area (approximately 537,800 feet^2), which includes the crash crew building and the northern portion of the site; 2) the concrete apron area (approximately 405,600 feet^2); 3) the parking lot area (approximately 266,200 feet^2); and 4) the parking area north of Building 1589 (approximately 9,000 feet^2). Both parking lot areas were added to Site 10 for the Phase II Remedial Investigation/Feasibility Study as requested by the California Environmental Protection Agency.

STEP 5 – DEVELOP A DECISION RULE

Action levels developed for decision-making purposes are a cumulative excess cancer risk of 10^{-6} in humans and a hazard index of 1.0 for chronic systematic toxicity in humans. Based on these risk levels, decision rules have been formulated to protect human health and the environment in residential, recreational, and industrial land use scenarios.

STEP 6 – SPECIFY LIMITS ON UNCERTAINTY

The number of samples necessary to estimate different levels of risk were calculated using the confidence level of 95 percent and power level of 80 percent limits specified for this project. The preliminary cancer and noncancer risk values were compared to the risk levels, and the appropriate number of samples necessary to estimate risk were selected for each unit.

STEP 7 – OPTIMIZE THE DESIGN

Shallow soil samples will be collected and analyzed at 0, 5, and 10 feet below ground surface at eight locations from the Aircraft Matting Area; 10 locations from the Concrete Apron Area; 12 locations from the New Parking Lot Area; and 2 locations from the North Parking Area of Building 1589 to assess impacted soil in these areas.

ACRONYMS/ABBREVIATIONS

ARAR	applicable or relevant and appropriate requirement
BCT	BRAC Cleanup Team
bgs	below ground surface
BRAC	Base Realignment and Closure
Cal/EPA	California Environmental Protection Agency
COPC	chemical of potential concern
CRDL	contract-required detection limit
DQO	data quality objective
EE/CA	Engineering Evaluation/Cost Analysis
FS	Feasibility Study
FSP	Field Sampling Plan
IDL	instrument detection limit
LUFT	(California) Leaking Underground Fuel Tank (Field Manual)
MCAS	Marine Corps Air Station
µg/kg	micrograms per kilogram
µg/L	micrograms per liter
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
NEESA	Naval Environmental and Energy Support Activity
NFESC	Naval Facilities Engineering Service Center
NFI	No Further Investigation
PAH	polynuclear aromatic hydrocarbons
PDA	Petroleum Disposal Area
QA/QC	quality assurance/quality control
RI	Remedial Investigation
RI/FS	Remedial Investigation/Feasibility Study
SAIC	Science Applications International Corporation
TFH	total fuel hydrocarbons

ACRONYMS/ABBREVIATIONS (continued)

TPH	total petroleum hydrocarbons
TRPH	total recoverable petroleum hydrocarbons
U.S. EPA	United States Environmental Protection Agency
VOC	volatile organic compound

Appendix J
SITE 10 – PETROLEUM DISPOSAL AREA

The United States Environmental Protection Agency (U.S. EPA) developed the data quality objectives (DQO) Process as a tool for project managers to determine the type, quantity, and quality of data needed to make decisions. Data produced by sampling and monitoring activities are used extensively in problem definition, rule-making, and enforcement decisions. These activities are supported through implementation of the mandatory U.S. EPA Quality System, which requires all organizations to develop and operate management processes and structures for assuring that the data collected are of the necessary and expected quality for their desired use (U.S. EPA 1993).

The U.S. EPA DQO process consists of the following seven steps.

1. **State the problem:** Describe the problem at the site as it is currently understood. The problem statement includes a site conceptual model and an organization and review of all relevant data.
2. **Identify the decision:** Determine an if-then statement that will define what the investigation will seek to determine and what actions will be taken based on the possible outcomes of the investigation.
3. **Identify inputs into the decision:** Specify the analytes or parameters to be measured and used.
4. **Define the study boundary:** Delineate the study boundary from information obtained from Step 1.
5. **Develop a decision rule:** Restate the decision detailing the if-then statement in specific terms.
6. **Specify acceptable limits on decision errors:** Specify how the data will be treated statistically and what the acceptable limits of uncertainty are.
7. **Optimize the design:** Design the field investigation, giving adequate consideration to the results of Steps 5 and 6. This step is described in more detail in the Field Sampling Plan (FSP).

The following sections describe the DQO process for Site 10 – Petroleum Disposal Area.

STEP 1 – STATE THE PROBLEM

Site 10 consists of four areas: a northern aircraft parking area covered by aircraft matting, a southern aircraft parking area covered by concrete, a vehicle parking lot south of the concrete aircraft apron, and the vehicle parking area on the northern sides of Building 1589. From 1952 through 1970, an estimated 52,000 gallons of waste fluids (waste oil, antifreeze, transmission fluids, and solvents) were applied to these areas for dust control. During the 1970s, the two large sprayed areas were excavated and concreted, or stabilized and covered with matting. Soil beneath Site 10 have been contaminated by previous waste disposal practices at the site.

Site Description

The Petroleum Disposal Area (PDA) is located south of Building 435 and east of Building 369, in the southern quadrant of Marine Corps Air Station (MCAS) El Toro (Figure J-1). The site comprises an area of about 23 acres. The site consists of four subareas: a northern area covered with aircraft matting; a southern area covered by concrete; the parking lot area; and the northwest and northeast sides of Building 1589. Site boundaries for the MCAS El Toro Phase I Remedial Investigation (RI) were determined by consensus between the Navy and regulatory agencies prior to initiation of the Phase I RI. Areas of concern were generally grouped together as sites based on common historical activities, aerial photograph review, and their locations with respect to each other.

From 1952 through 1970, an estimated 52,000 gallons of wastes (crankcase oil, antifreeze, hydraulic, and transmission fluids, motor oil, and solvents) were sprayed on this area for dust control. During the 1970s, the sprayed areas were excavated and concreted or built over.

The northern portion of the PDA is covered with aircraft matting that was installed in 1973. During the installation of the aircraft matting, top soil was mixed with dry cement, then wetted to solidify it in place.

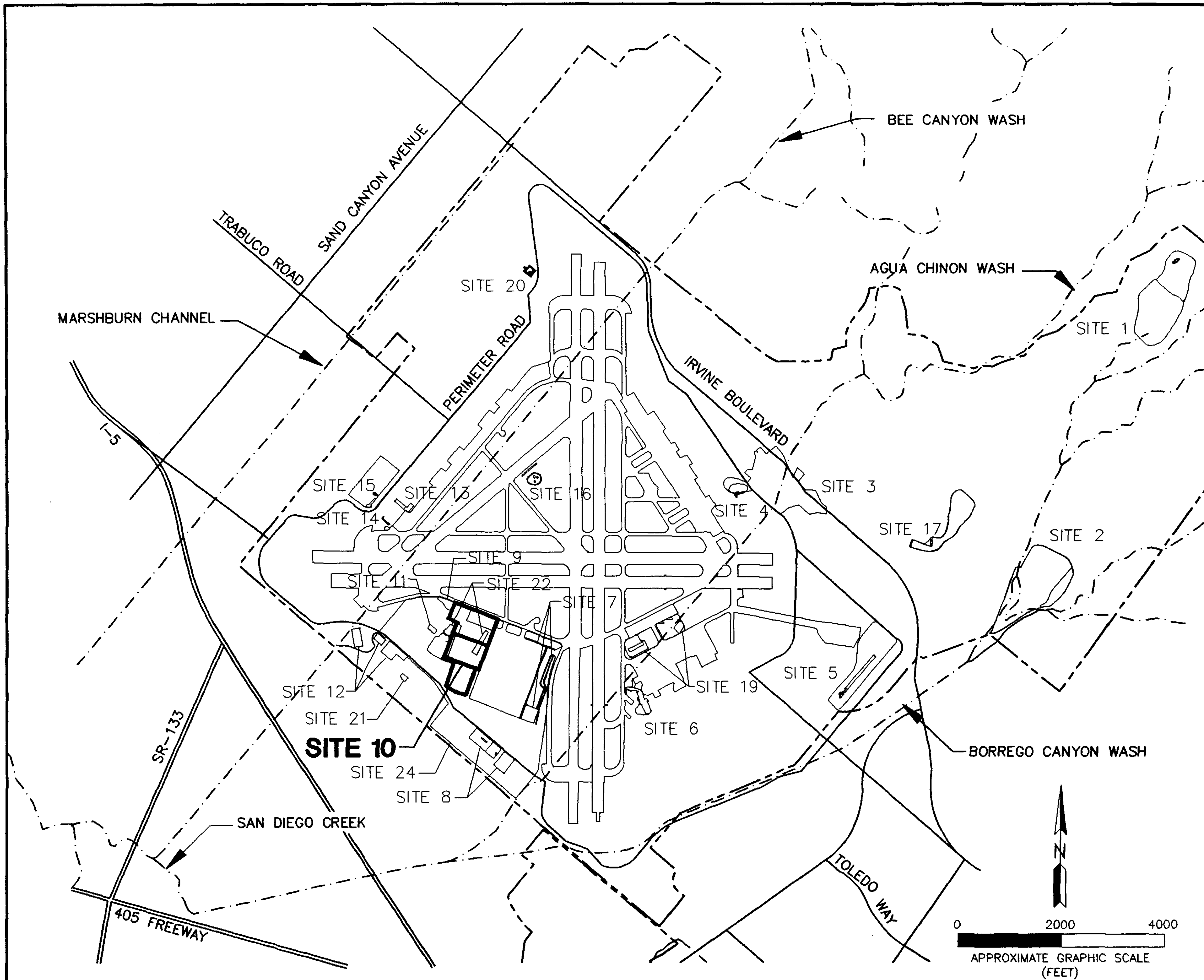
The southern portion of the PDA was covered with a concrete apron in 1971. As a part of the construction, the top soil underneath this portion of the PDA was excavated to a depth of 2 feet. The excavated soil was transported to the land farm area northwest of Bee Canyon Wash and eventually to the Magazine Road Landfill.

Based on regulatory comments, Site 10 has been expanded for the Phase II RI/Feasibility Study (FS) to include a new parking lot area south of the concrete apron. The Science Applications International Corporation (SAIC) aerial photograph survey, noted an extremely dark stained area in the area on photographs from 1961 and 1964. Trichloroethene and tetrachloroethene were detected in subsurface soils during a soil gas survey (Jacobs Engineering 1994a) that was conducted over this area, while investigating Site 24, the volatile organic compounds (VOC) Source Area. Based on these data, Site 10 will be expanded for the Phase II RI/FS to include the area south of the concrete apron (new parking lot area).

Based on regulatory comments, Site 10 has also been expanded to include an area north of Building 1589. This is the area (Unit 4 – the parking area north of Building 1589) where bowsers were located that stored the waste products (crankcase oil, antifreeze, hydraulic and transmission fluids, motor oil, and solvents) that were sprayed for dust control on Site 10.

Previous Investigations

Several investigations have been conducted in the area of Site 10, these are the Phase I RI, and aerial photograph surveys, and a soil gas survey. The sections below provide a summary of these investigations.



Work Plan Appendix J

Figure J-1
Site Location
Site 10 - Petroleum Disposal Area

MCAS El Toro, California

CLEAN II Program

Date: 6/13/95
File No. slocr-10
Job No. 22214-059

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PHASE I REMEDIAL INVESTIGATION

For the Phase I RI, subareas within sites were designated as strata. Due to the fact that some new subareas have been added or subareas have been expanded or diminished for the Phase II RI/FS, subareas within sites will be referred to as units for the Phase II RI/FS. In this section, discussion is related to Phase I RI sampling and results, and the term strata will be used. Following this section, the term unit will be used.

For the Phase I RI, Site 10 was represented by two strata (Figure J-2):

- Stratum 1 – the Aircraft Matting Area; and
- Stratum 2 – the Concrete Apron Area.

The following field investigation activities (Figure J-2) were conducted as part of Phase I RI (Jacobs Engineering 1993a):

- surface and shallow soil samples (0 to 4 feet below ground surface [bgs]) were collected from six locations in Strata 1 and 2;
- two 25-foot-deep borings (one in each stratum), and one 123-foot-deep boring in Stratum 1 were drilled and sampled;
- drilling, sampling, and installing one downgradient well; and
- soil and groundwater samples were analyzed for target analyte list (TAL) metals, VOC, semivolatile organic compounds (SVOC), total fuel hydrocarbons (TFH)-diesel and -gasoline, total recoverable petroleum hydrocarbons (TRPH), and pesticides/polychlorinated biphenyls.

A summary of the ranges of analyte concentrations detected during the Phase I RI (sample identification of the highest concentration is provided), plus recent groundwater monitoring data is presented below. All chemicals of potential concern (COPCs) that were detected in soil are listed with the exception of specific metals, which are listed only if they exceed U.S. EPA Region IX Preliminary Remediation Goals (PRGs) or ecological screening criteria in shallow soil. All COPCs that exceed PRGs or maximum concentration levels (MCLs) in groundwater are included in this list. If a minimum concentration is recorded with a "less than" symbol, it denotes a concentration below the contract laboratory program detection limit. Sample locations are shown on Figure J-2. A complete listing of all detected chemicals is presented in the Phase I RI Technical Memorandum, Appendix B-10, Tables B10-2 through B10-7 (Jacobs Engineering 1993a), and in the Groundwater Quality Data Report (Jacobs Engineering 1994a). TAL metals that were analyzed during the Phase I RI are beryllium, barium, arsenic, antimony, aluminum, cadmium, calcium, cobalt, copper, iron, lead, magnesium, manganese, mercury, nickel, potassium, selenium, silver, sodium, thallium, vanadium, and zinc.

Shallow Soil (less than 10 feet below ground surface)

- metals: 22 of 23 TAL metals;

- VOCs: 1,2 dichloroethene, total (< 11 to 6J micrograms per kilogram [μg/kg] [10_GN5 at 0 feet]), acetone (< 11 to 130 μg/kg [10_GN4 at 0 feet]), tetrachloroethene (< 11 to 19 μg/kg [10_GN5 at 0 feet]), toluene (< 11 to 18 μg/kg [10_GN4 at 4 feet]);
- SVOCs: benzo(a)anthracene (< 700 to 350J μg/kg [10_GNI at 0 feet]), benzo(a)pyrene (< 700 to 380J μg/kg [10_GN1 at 0 feet]), benzo(b)fluoranthene (< 700 to 370J μg/kg [10_GN1 at 0 feet]), benzo(k)fluoranthene (< 700 to 230J μg/kg [10_GN1 at 0 feet]), benzo(g,h,i)perylene (< 700 to 220J μg/kg [10_GN1 at 0 feet]), bis(2-ethylhexyl) phthalate (< 700 to 280J μg/kg [10_GN1 at 0 feet]), chrysene (< 700 to 460J μg/kg [10_GN1 at 0 feet]), diethyl phthalate (< 700 to 240J μg/kg [10_GN2 at 0 feet]), fluoranthene (< 700 to 770 μg/kg [10_GN1 at 0 feet]), indeno(1,2,3-cd)pyrene (< 700 to 290J μg/kg [10_GN1 at 0 feet]), phenanthrene (< 700 to 340J μg/kg [10_GN1 at 0 feet]), pyrene (< 700 to 780 μg/kg [10_GN1 at 0 feet]); and
- fuel and petroleum hydrocarbons: TFH-diesel (< 13.2 to 38.3 milligrams per kilogram [mg/kg] [10_GN2 at 0 feet]), TFH-gasoline (< 0.053 to 0.117 mg/kg [10_GN2 at 0 feet]), TRPH (< 20 to 532 mg/kg [10_GN4 at 0 feet]).

Subsurface Soil (greater than 10 feet below ground surface)

- metals: 21 of 23 TAL metals;
- VOCs: 2-butanone (< 10 to 3J μg/kg), acetone (< 10 to 76 μg/kg), methylene chloride (< 11 to 4J μg/kg); and
- fuel and petroleum hydrocarbons: TFH-gasoline (< 0.051 to 0.357 mg/kg), TRPH (< 20 to 529 mg/kg).

Groundwater (10_DGMW77 downgradient)

- general chemistry: nitrate/nitrite-N (15.8 to 16.2 milligrams per liter [mg/L]), TDS (1,030 to 1,100 mg/L);
- metals: arsenic (1.5B to 2.5B micrograms per liter [μg/L]), selenium (15.4B to 18.4 μg/L), and 11 other TAL metals;
- VOCs: 1,1 dichloroethene (< 1 to 0.6J μg/L), carbon tetrachloride (2 to 3 μg/L), chloroform (1 to 2 μg/L), methyl chloride (< 2 to 1J μg/L), tetrachloroethene (3 to 8 μg/L), trichloroethene (35D to 61D μg/L); and
- SVOCs: benzyl butyl phthalate (< 10 to 19 μg/L).

J = Indicates an estimated value for qualitative use only (organic parameters).

B = Indicates reported value is less than the contract-required detection limit (CRDL), but greater than the or equal to the instrument detection limit (IDL) (inorganic parameters).

D = The value for this compounds is from a diluted analysis.

Work Plan Appendix J

Figure J-2
Proposed Subsurface Sampling Locations
Site 10 - Petroleum Disposal Area

MCAS El Toro, California

CLEAN II Program

Date: 7/7/95
File No. site10
Job No. 22214-059

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Concentrations of COPCs detected in shallow soil at Site 10 during Phase I RI were compared to PRGs and ecological screening criteria. The results of this comparison are shown below (Jacobs Engineering 1993a, page A10-7 and Table A10-3a):

- benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, indeno(1,2,3-cd)pyrene, exceed PRGs and ecological criteria in Stratum 1; and
- no COPCs exceed PRGs or ecological criteria in Stratum 2.
- The concentrations of COPCs detected in groundwater samples were compared to PRGs and MCLs. The results of that comparison are shown below (Jacobs Engineering 1993a, page A10-7 and Table A10-3b):1,1-dichloroethene, carbon tetrachloride, tetrachloroethene, trichloroethene, arsenic, and nitrate/nitrite-N exceeded PRGs; and
- carbon tetrachloride, tetrachloroethene, trichloroethene, nitrate-N, selenium, and TDS exceeded MCLs.

Petroleum hydrocarbons detected in shallow soil samples were also compared to California Leaking Underground Fuel Tank (LUFT) Field Manual guidelines (LUFT 1989) to evaluate their potential to migrate to the groundwater. Based on LUFT guidelines, petroleum hydrocarbons in shallow soils in Strata 1 and 2 do not appear to pose a threat to groundwater at this site.

U.S. EPA AERIAL PHOTOGRAPH SURVEY

The review of U.S. EPA aerial photographs survey showed that the area sprayed with waste oils and other fluids for dust control varied over the years, but generally increased in size between 1952 and 1970. In the 1973 photograph, the northern portion of the site was covered with aircraft matting, and the concrete apron is visible in the southern portion (Jacobs Engineering 1993b).

SCIENCE APPLICATIONS INTERNATIONAL CORPORATION AERIAL PHOTOGRAPH SURVEY

The assessment of SAIC photographs identified two open storage areas with possible drums and a stain area in the southern portion of the site as early as 1964. Wet soil and liquid flow were observed at the northern edge of the site on the 1968 photograph. Seven possible tanks, wet soil, and flowing liquid were identified west of Building 435 on the 1973 photograph (SAIC 1993).

EMPLOYEE INTERVIEWS

A 26 May 1994 meeting was held at MCAS El Toro to interview active and retired personnel from the Station Fuel Operations Division and Facility Management Department (currently the Installations Department) who had knowledge of Station operations and procedures for the storage/disposal of hazardous materials and waste. Participating as interviewers during the meeting were agency personnel, Navy and Station personnel, and personnel contracting for the Navy and U.S. EPA. During these interviews the following information pertaining to Site 10 was obtained (Jacobs Engineering 1994c).

- When the area was graded for the extension of the tarmac, petroleum contaminated soil was excavated and transported to the land farm area northwest of Bee Canyon Wash, and to the Magazine Road Landfill. The panel of interviewees could not recall specific trenches on Site 10.
- A storm drain trench was located adjacent to the northwest edge of the original parking apron. The drain was used to divert surface runoff away from the apron. Also, a fuel bladder (Site 22) was located near the same edge of the parking apron.
- Spreading waste liquids over unpaved soil was a common practice for dust control for many years (from mid-1940s through 1970). The panel thought this practice could have contributed to groundwater contamination.

SOIL GAS SURVEY

In 1994, a soil gas survey was conducted for Sites 24 and 25 in the southwest quadrant of the MCAS El Toro. The source of the regional VOC groundwater plume is believed to be located in this area of the Station. During this investigation, both soil gas and soil samples were collected from approximately 15 and 30 feet bgs at 465 locations. Soil gas samples were analyzed for VOC, TPH (gasoline and diesel), and benzene, toluene, ethylbenzene, and xylenes. Soil samples were analyzed for VOC.

Results obtained from the soil gas survey data indicate that VOC were detected in subsurface soil samples in the aircraft matting area. VOC were not detected in subsurface soils in the concrete apron area. However, trichloroethene and tetrachloroethene were detected in subsurface soils in the new parking lot area to the south of the concrete apron (Jacobs Engineering 1994b).

Geology

The geology of Site 10 consists of Quaternary alluvial and marine deposits (Jacobs Engineering 1993a). Holocene deposits consist of a matrix of fined-grained overbank deposits and some coarse-grained stream channel deposits. These soils are derived from the Santa Ana Mountains to the east and conformably overlie Pleistocene interbedded fine grained lagoonal and near-shore marine deposits. Pleistocene deposits could not be differentiated from Holocene deposits in Phase I RI soil borings. Pleistocene deposits unconformably overlie semiconsolidated marine sandstones, siltstones, and conglomerates of late Miocene to late Pliocene, which are considered to be bedrock in the area.

Based on a review of boring logs from the Phase I RI, the subsurface lithology at Site 10 consists of layered sequences of sands, silts, and sandy and silty clays. Well-defined permeable units, such as well-sorted sands, are infrequent.

Hydrogeology

MCAS El Toro lies within the Irvine Groundwater Basin, a subbasin of the Los Angeles groundwater basin. Regional aquifers in the Irvine Subbasin tend to be composed of discontinuous lenses of clayey and silty sands and fine-grained gravels contained within a complex assemblage of sandy clays and sandy silts. Three general aquifer systems have been identified near the Station: a shallow and perched system, a principal aquifer zone, and a lower hydrogeologic system existing in bedrock (Jacobs Engineering 1993a).

The Phase I RI results indicate that the shallow, perched zone is not present at Site 10. The principal aquifer is the main water-producing zone for the Irvine area. The principal aquifer is encountered about 120 feet beneath Site 10. The regional groundwater flow direction in the area of the site is generally to the northwest. The hydraulic gradient in the area of the site has been influenced strongly by the pumping of irrigation wells located west of MCAS El Toro.

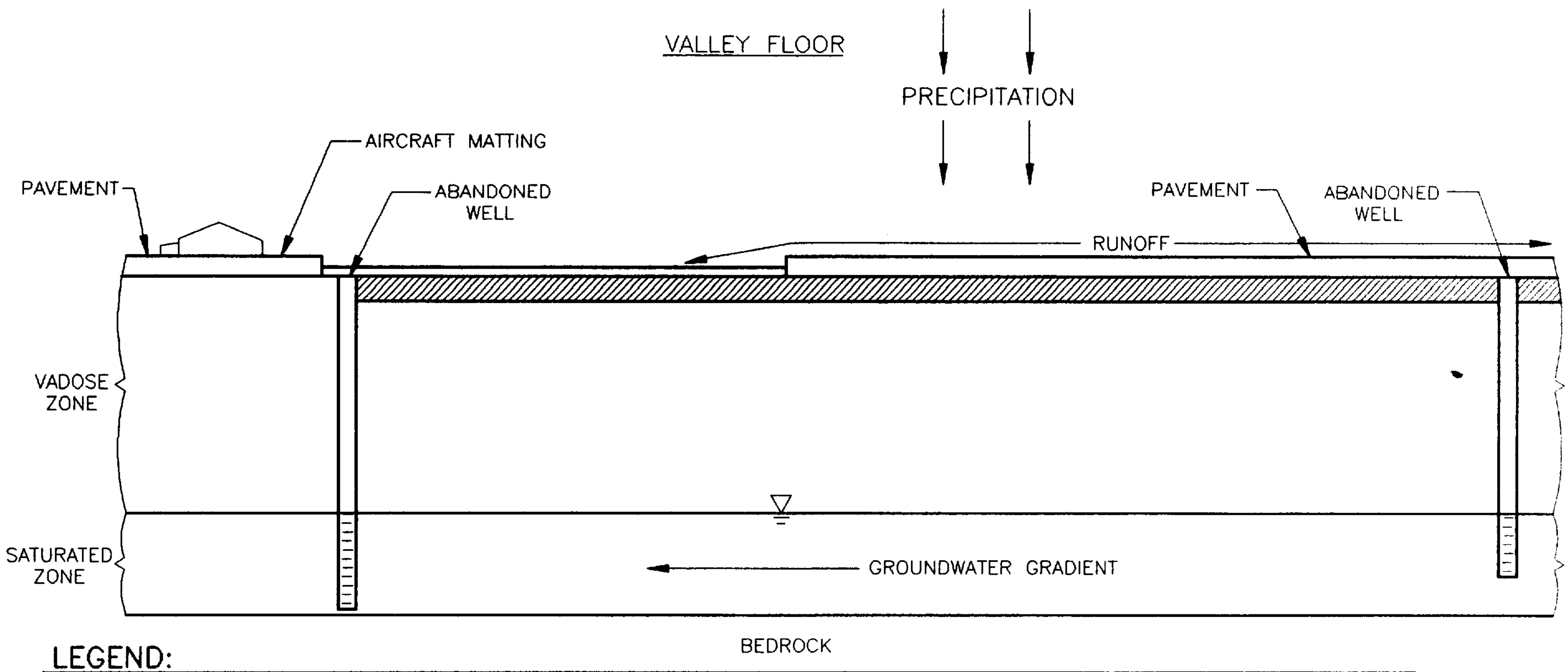
Conceptual Site Model

In the process of developing a conceptual site model, release mechanisms and potential sources of contamination were considered and evaluated to determine their applicability to the site. Also considered in the development of the conceptual site model were potential receptors and contaminant pathways to potential receptors. Figure J-3 illustrates the conceptual site model developed for the site. Figure J-4 depicts the potential exposure routes and pathways for human and ecological receptors.

The primary release mechanism is contaminants released to surface and shallow soil from application of all organic wastes for dust control that occurred frequently from 1952 through 1970 in the Petroleum Disposal Area (Site 10). Eventually under gravity, contaminants present in surface and shallow soil may move downward with soil moisture (as dissolved phase) or as a discrete liquid phase. The depth of groundwater at this site is reported to be about 120 feet bgs.

The secondary source of contaminants is the surrounding soil impacted by the primary release mechanism (application of organic wastes onto surface soil). Fugitive dust release is unlikely since organic wastes were applied for dust control. Also, at the present time the site is covered with concrete apron, aircraft matting, or asphalt. Volatilization of organic chemicals is unlikely (as secondary release mechanism) at this site. Also, the fact that the site area has been paved since 1973 suggests that percolation or infiltration of contaminants present in the impacted surface soil to the subsurface soil is an unlikely secondary release mechanism.

The potential pathways are air and groundwater. Surface water is unlikely pathway at this site. Airborne contaminants are transported through fugitive dust and volatilization. The transport through air is affected by wind speed and direction, type of contaminant, and weather conditions. Typically, winds at MCAS El Toro are from west/southwest at less than 10 knots. Transportation of airborne contaminants through volatilization is an unlikely pathway at this site. The mean annual rainfall at MCAS El Toro is about 14.0 inches, most of it occurs from November through April.



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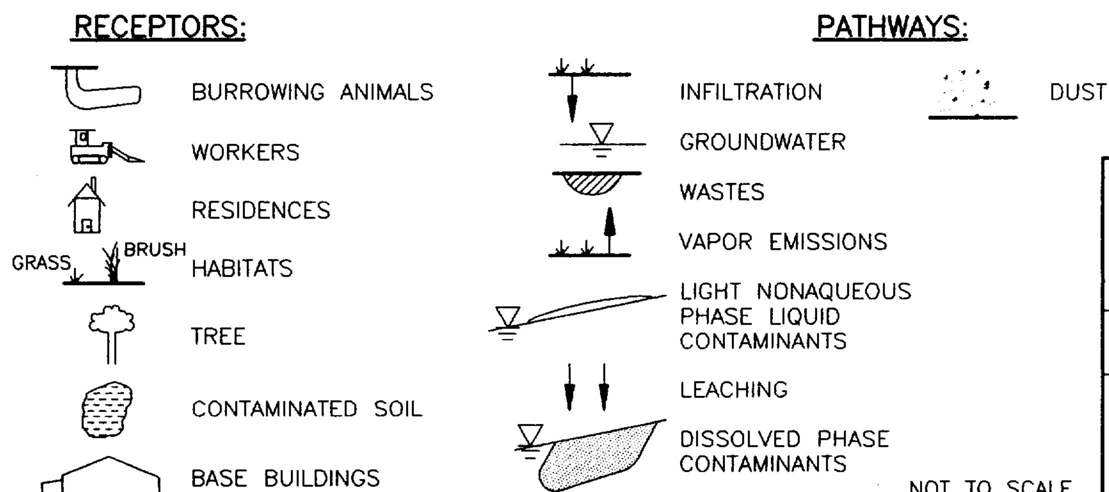

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Work Plan Appendix J

Figure J-3

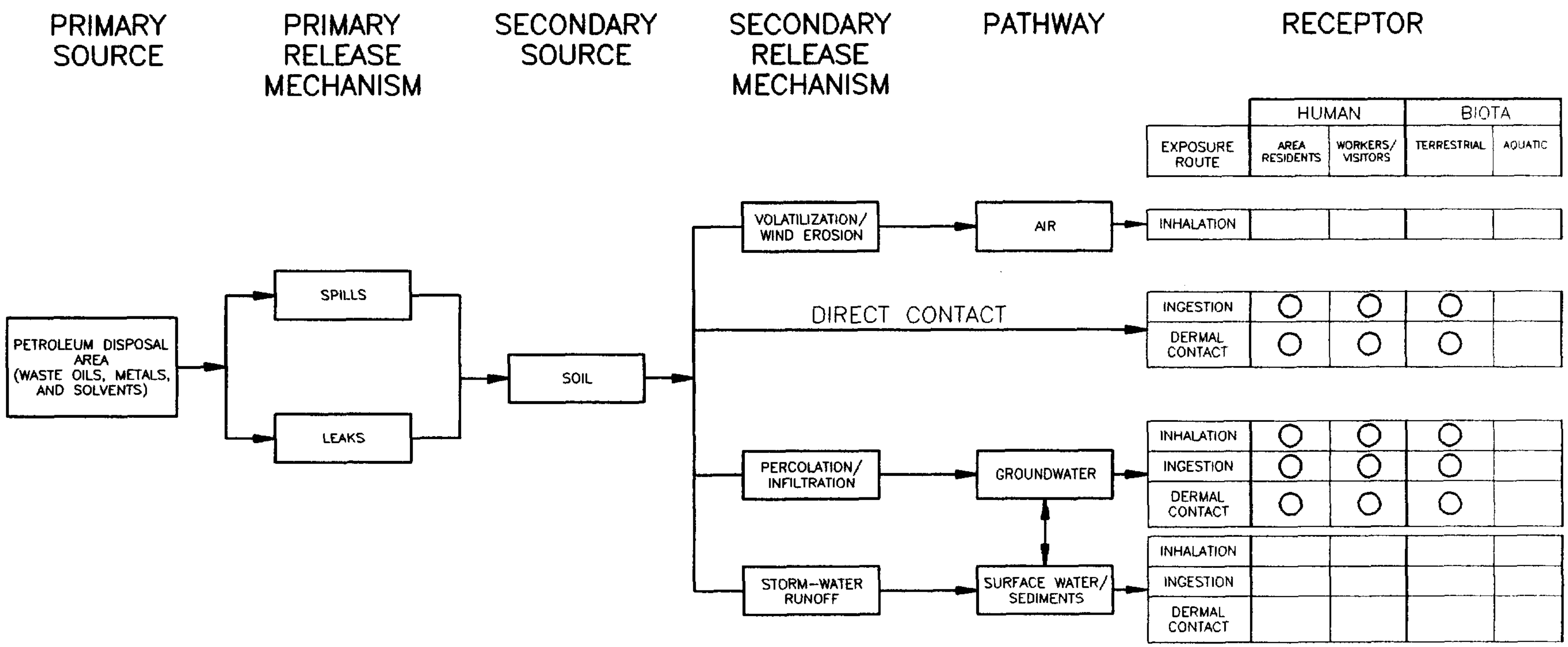
Conceptual Site Model

Site 10 - Petroleum Disposal Area

MCAS El Toro, California

CLEAN II Program

Date: 6/29/95
File No. model-10
Job No. 22214-059



LEGEND:

● CURRENT POTENTIAL RECEPTOR

○ FUTURE POTENTIAL RECEPTOR

Work Plan Appendix J

Figure J-4

Exposure Routes and Receptors
Site 10 - Petroleum Disposal Area

MCAS El Toro, California

CLEAN II Program

Date: 6/28/95
File No. mod10
Job No. 22214-059

Current and/or potential receptors of chemicals at this site via inhalation are workers and visitors involved in various activities. Direct contact with surface and subsurface soils is unlikely via dermal or ingestion exposures of workers. Thus, workers are not potential receptors to surface and subsurface soils via ingestion and dermal contact exposure routes. Infiltration of contaminated water through the vadose zone into groundwater is minimal because groundwater at 120 feet bgs, rainfall is only 14 inches/year, and the site areas are covered with concrete pavement or aircraft matting.

Presently, the entire site is covered by aircraft matting over cemented soil, concrete, or asphalt. If these surface covers were removed, terrestrial wildlife could be exposed to chemicals in on-site surface soil, and dust and vapors through ingestion, dermal absorption, or inhalation. Terrestrial plants could also be exposed through root absorption of chemicals in surface soil or deposition of dusts. No special-status species were observed at this site, and the immediate area provides marginal habitat for wildlife species.

Statement of Phase II RI/FS Problem

The Petroleum Disposal Area Site 10 is located south of Building 435 and east of Building 369, in the southern quadrant of MCAS El Toro. The problems associated with this site are as follows:

- shallow subsurface soil at Site 10 is impacted with VOCs, SVOCs, petroleum hydrocarbons, and possibly metals;
- soil sample analytical data do not suggest that site activities have impacted groundwater;
- based on LUFT guidelines, petroleum hydrocarbons in shallow soil do not appear to pose a threat to groundwater; and
- more data are necessary to calculate a cumulative excess cancer risk and hazard index for the site.

STEP 2 – IDENTIFY THE DECISION

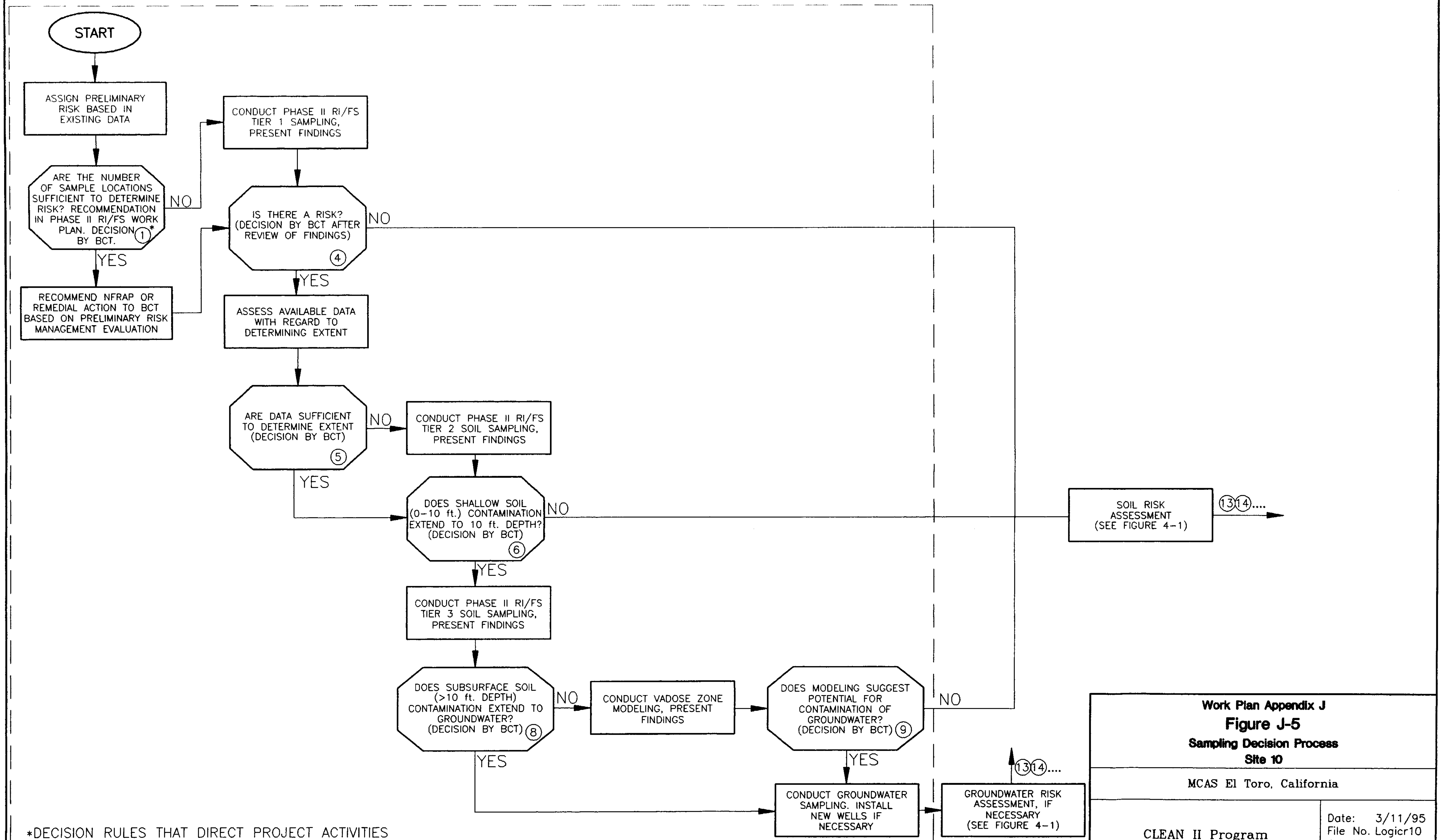
This step describes the decisions that will be considered during the DQO process for Site 10. For each decision, the alternative outcomes are stated. The Sampling Decision Process is illustrated on Figure J-5. For Site 10, the following decisions will be considered:

1. Do COPCs in shallow soil (less than 10 feet bgs) in the unit exceed established background concentrations and PRGs, and/or do they present an unacceptable risk to human health or the environment?

   If yes, proceed to the next decision.

   If uncertain, collect additional soil samples to determine risk.

   If no, recommend the unit for No Further Investigation (NFI).



Work Plan Appendix J

Figure J-5

Sampling Decision Process

Site 10

MCAS El Toro, California

CLEAN II Program

Date: 3/11/95
File No. Logicr10
Job No. 22214-059

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2. Has the extent of impacted soil been defined in the shallow soil?

   If yes, evaluate a response action.

   If no, conduct soil sampling to define extent.

3. Does the extent of impacted shallow soil extend into the subsurface (greater than 10 feet bgs)?

   If yes, conduct soil sampling to define vertical extent of impacted soil, and if necessary, evaluate potential impacts to groundwater beneath the site.

   If no, evaluate a response action.

4. Do the media being evaluated for a response action qualify for Early Action?

   If yes, recommend unit for an Engineering Evaluation/Cost Analysis (EE/CA).

   If no, recommend unit for a remedial response as part of the RI/FS process.

STEP 3 – IDENTIFY THE INPUT AFFECTING THE DECISION

Step 2 defined the decisions addressing possible actions at the site. Step 3 will identify the inputs that are required to assess the actions as discussed below.

Inputs for No Further Investigation

Input information required to support a NFI recommendation will also be used to support decisions for Early Action and Long-Term Action. These inputs are listed as follows:

- list of COPCs;
- definition of the extent of impacted soil;
- background concentrations for metals, pesticides, and herbicides;
- determination of risk for the unit; and
- action levels for the protection of human health and the environment.

Inputs for Early Action

In addition to the inputs required for a NFI recommendation, input information required to support an Early Action recommendation will include the following:

- applicable or relevant and appropriate requirements (ARARs);
- identification of cleanup standards;
- identification of cleanup technology applicability/limitations that are not extensive operation and maintenance activities; and
- site/unit cleanup in less than 5 years.

Inputs for Long-Term Action

In addition to the inputs required for a NFI recommendation, input information required to support a Long-Term Action recommendation may include the following:

- ARARs;
- identification of cleanup standards;
- identification of cleanup technology applicability/limitations;
- pilot testing of remedial alternatives; and
- site/unit cleanup in more than 5 years.

Descriptions of Inputs

The following subsections discuss the inputs required to assess possible response actions.

CHEMICALS OF POTENTIAL CONCERN

COPCs for Site 10 include all chemicals detected in the Phase I RI for each medium (Jacobs Engineering 1993b, pages A10-4 to A10-5). COPCs for Site 10 are listed below.

Shallow Soil

- metals: aluminum, antimony, arsenic, barium, beryllium, cadmium, cobalt, copper, lead, manganese, mercury, nickel, selenium, silver, thallium, vanadium, zinc;
- VOCs: 1,2-dichloroethene, acetone, tetrachloroethene, toluene, xylenes;
- SVOCs: benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, bis(2-ethylhexyl) phthalate, chrysene, diethylphthalate, fluoranthene, indeno(1,2,3-cd)pyrene, pheanathrene, pyrene; and
- fuel and petroleum hydrocarbons: TFH-diesel and -gasoline, TRPH.

Subsurface Soil

- metals: aluminum, antimony, arsenic, barium, beryllium, cadmium, cobalt, copper, lead, manganese, mercury, nickel, selenium, silver, thallium, vanadium, zinc;
- VOCs: 2-butanone, 1,2-dichloroethene, acetone, methylene chloride, tetrachloroethene, toluene, xylenes;
- SVOCs: benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, bis(2-ethylhexyl) phthalate, chrysene, diethylphthalate, fluoranthene, indeno(1,2,3-cd)pyrene, pheanathrene, pyrene; and
- fuel and petroleum hydrocarbons: TFH-diesel and -gasoline, TRPH.

Groundwater (On-Site)

- metals: antimony, arsenic, barium, copper, manganese, nickel, selenium, vanadium, zinc;
- VOCs: 1,1-dichloroethylene, carbon tetrachloride, chloroform, methyl chloride, tetrachloroethylene, trichloroethylene;
- SVOCs: benzyl butyl phthalate; and
- fuel and petroleum hydrocarbons: TFH-diesel and -gasoline, TRPH.

THE NATURE AND EXTENT OF CONTAMINATION

Phase II RI/FS sample locations, depths, and chemical analyses have been designed to assess the risk associated with the site. Additional sampling will be conducted if it is necessary to further define the extent of impacted shallow soil, subsurface soil, or groundwater.

BACKGROUND CONCENTRATIONS

The background concentrations for metals, herbicides, and pesticides are presented in Section 4 of the Phase II RI/FS Work Plan.

DETERMINATION OF RISK

A determination of the human health risk associated with each site is based on a baseline or streamline risk assessment. Baseline risk assessments are performed on RI/FS sites. The objective of a baseline risk assessment is to estimate the risks associated with the no action alternative and thereby provide decision makers information useful in identifying the most appropriate remedial action alternative. The risk estimates produced also serve as a benchmark to which reductions in risk achieved by remedial actions may be compared. Streamlined risk assessments are performed on removal action sites to support the removal action.

In addition to the human health risk assessment conducted for a site, an ecological risk assessment may also be performed. The ecological risk assessment will evaluate current and potential risks to the environment posed by the chemical releases that have occurred at the sites.

IDENTIFICATION OF CLEANUP LEVELS

Cleanup levels will be based on ARARs, background concentrations, and risk levels that will be determined for the site.

CLEANUP TECHNOLOGY EFFECTIVENESS, IMPLEMENTABILITY, AND COSTS

Once cleanup levels have been established, the most appropriate and cost-effective approach will be identified to remediate the site, if necessary.

STEP 4 – DEFINE THE BOUNDARIES OF THE STUDY

This step defines the spatial and temporal boundaries of the problem and any practical constraints that may interfere with the study.

- Unit 1 – the Aircraft Matting Area (approximately 537,800 feet^2 and includes the crash crew building and the northern portion of the site. This unit has the same boundaries as the Phase I RI, Site 10, Stratum 1).
- Unit 2 – the Concrete Apron Area (approximately 405,600 feet^2 and includes area adjacent and south of Unit 1. This unit has the same boundaries as the Phase I RI, Site 10, Stratum 2).
- Unit 3 – the Parking Lot Area (approximately 266,200 feet^2 and was created for the Phase II RI/FS to investigate an area as requested by the California Environmental Protection Agency (Cal/EPA). Aerial photographs of this area revealed staining throughout the years. Results of the soil gas survey, indicate the presence of trichloroethene and tetrachloroethene in the subsurface beneath this unit).
- Unit 4 – the Parking Area north of Building 1589 (approximately 9,000 feet^2 was created for the Phase II RI to investigate an area requested by Cal/EPA where waste products were stored prior to being sprayed for dust control over the area of Site 10).

Specification of temporal boundaries for the field sampling activities is unnecessary. Shallow and deeper subsurface soil conditions are not considered to be significantly different from conditions during the Phase I RI sampling or throughout the period since spillage or unregulated waste disposal activities occurred on the site.

STEP 5 – DEVELOP A DECISION RULE

Decision rules are required to state explicitly the types of inputs and logical basis for choosing among alternative actions during the Phase II RI/FS. A list of all decision rules for the project are included in Section 4 of the Work Plan. The specific decision rules that will be followed to determine an action are presented here. These decision rules conform to the numbering sequence presented in Section 4 of the Work Plan.

2. If Phase I data are sufficient to assess a response action to reduce risk associated with site units which exceed media action levels or background concentrations, then the cleanup levels and appropriate response action (Early Action or Long-Term Action) will be determined.
3. If Phase I data are not sufficient to assess whether risks are present based on the minimum number of samples, then Tier 1 sampling of the Phase II RI/FS will be completed to supplement the Phase I analytical results so the minimum number of samples is satisfied to assess whether action levels or background concentrations are exceeded in site units.

4. If Phase I data and Tier I data for the Phase II RI/FS indicate that no solid wastes are exposed and respective action levels or background concentrations for the various media of a site unit are not exceeded, then NFI will be recommended.
5. If Phase I data or Tier 1 data of the Phase II RI/FS combined with Phase I data exceed PRGs, action levels, or background concentrations for the various media, then Tier 2 of the Phase II RI/FS sampling and analyses will be conducted to define horizontal and vertical extent, provided additional sampling costs are not more than a potential response action.
6. If PRGs, action levels, or background concentrations for shallow soil are exceeded, and if COPCs detected in the soil extend to 10 feet bgs, then soil below 10 feet bgs (subsurface soil) will be investigated to assess the horizontal and vertical extent of the COPCs.
7. If during the investigation of COPCs in subsurface soil, two consecutive soil sample analyses (at a minimum 5-foot-depth separation) demonstrate that COPCs are not detected, then the vertical extent of soil contamination will be established and investigation of subsurface soil will be halted at that location. The horizontal extent will be established when COPCs are not detected in vertical samples taken at three locations around the sample that exceeds the action levels.

   The lowest detection limit available will be used to define the base of a contaminant plume. COPC detection or quantitation limits that will be compared to establish the base of the contaminant plume include the following:

   - CRDL,
   - contract-required quantitation limit,
   - sample quantitation limit,
   - estimated quantitation limit,
   - practical quantitation limit,
   - method detection limit, and
   - IDL.

8. If during the investigation of COPCs in subsurface soil, it is determined by actual sampling that COPCs extend to the water table, groundwater beneath the site will be investigated for the presence of the COPCs.
9. If COPCs are identified in subsurface soil below 10 feet bgs, above background and action levels, but do not extend to the water table, then vadose zone computer modeling will be used to evaluate the potential for the COPCs to impact groundwater.
10. If it is determined that COPCs in subsurface soil have impacted groundwater causing exceedance of action levels, then the vertical and horizontal extent of groundwater exceedance will be evaluated.

13. If action levels or background concentrations are exceeded for the media of a site unit, then the risk assessment will be initiated, based on sample results, acceptable levels of risk, and potential land uses, to assess potential risks to human health and/or the environment.

14. If unacceptable risks are assessed to human health or the environment, then cleanup levels will be evaluated for each media.

15. If cleanup levels in a given medium are exceeded, and if the site meets at least one of the eight criteria for removal action described in 40 *Code of Federal Regulations* 300.415(b)(2), and the scale and complexity of contaminant distribution in the affected medium are such that excess risk can be expediently reduced utilizing readily available technology, then the medium at the site will be recommended for Early Action.

16. If an early removal action is selected, a non-time-critical EE/CA and Action Memorandum will be completed for the removal action.

17. Once the removal action is completed, the site will be evaluated for residual risk. If a residual risk exists, then a Long-Term Action may be required.

18. If cleanup levels for a given medium are exceeded, and if the site does not meet criteria for an Early Action, then the affected medium will be recommended for long-term remedial action as part of the RI/FS process; an FS will be completed, followed by a Record of Decision, Remedial Design, and Remedial Action to clean up the site for closure.

STEP 6 – SPECIFY LIMITS ON UNCERTAINTY

The purpose of Step 6 is to specify the tolerance limits for decision errors, which are used by the decision makers to establish performance goals for the data collection design. The objective of the data collection design is to obtain data that reliably estimate the true nature of environmental conditions at Site 10. This process is presented in Section 4 of the Work Plan and the following presents specific information on Site 10.

Identify the Null Hypothesis and Specify the Decision Errors

The null hypothesis for this site specifies that the concentrations of one or more of the COPCs exceed PRGs or risk-based action levels and represent an unacceptable risk at the site.

The alternative hypothesis for this site specifies that the concentrations of one or more of COPCs do not exceed PRGs or risk-based actions levels and represent an acceptable risk at the site. The false-positive and false-negative decision errors are discussed in Section 4 of the Work Plan.

Decision Error Limits

For the Phase II RI/FS, the allowable probability of making a false-positive decision has been designated as 0.05 (confidence of 95 percent) and an allowable probability of making a false-negative decision error has been designated as 0.20 (power of 80 percent).

Calculating the Number of Samples Necessary to Determine Risk

The number of sample locations necessary to determine the risk at a unit or a site were estimated using the process presented in Section 4 of the Work Plan. The number of additional sample locations needed to assess risk during the Phase II RI/FS is the difference between the total number of sample locations and the number of locations sampled during the Phase I RI (Table J-1).

Sampling Designs for the Operable Unit-3 Sites

Two types of sampling designs will be used to determine the soil conditions at Site 10. These sampling designs are:

- areal systematic random sampling based on a grid, and
- judgmental sampling.

A description of these Phase II RI/FS sampling designs is presented in Section 4 of the Work Plan. The first sampling design utilizes random positioning to produce an unbiased configuration of sample locations. The advantage of a random, unbiased sampling design is that the tolerance limits for false-positive and false-negative decision errors can be applied to the sample data and the risk decisions can be assigned a level of confidence.

The other sampling design is judgmental sampling. The purpose of judgmental sampling is to provide answers to more specific questions or issues where considerable information on the parameters of a population already exist. Confidence and power limits associated with statistically based sampling designs do not apply to judgmentally located samples. Decision errors must still be considered for judgmental samples; however, they will not be evaluated statistically. The decision errors associated with judgmental sampling are based on sample design errors and measurement errors. Assuming the best possible professional judgment was used to position the judgmental sample locations using existing data for the site, the most important decision errors will be associated with field and laboratory techniques involved with collection of the data. This makes careful application of field and laboratory techniques even more critical due to the fact that corroborative data from multiple samples may not be available, nor will it be statistically evaluated.

Table J-1
Summary of Phase II RI/FS OU-3 Soil Sampling Strategies

Description	Unit Area	Estimated Risk[a]	Maximum Number of Locations/ Samples[b]	Number of Phase I Locations/ Samples	Number of Phase II Locations/ Samples	Tier	Type of Sampling Strategy
Site 10–Petroleum Disposal Area	Unit 1–537,800 ft^2	9×10^{-6} (< 0.01)	12(36)	4(11)	8(24)[c]	1	Areal Systematic Random
	Unit 2–405,600 ft^2	$< 10^{-6}$ (< 0.01)	14(42)	4(8)	12(36)[c]	1	Areal Systematic Random
	Unit 3–266,200 ft^2	UNK	12(36)	0	12(36)[c]	1	Areal Systematic Random
	Unit 4–9,000 ft^2	—	2(6)	0	2(6)	1	Judgmental-per regulators

Notes:

[a] These estimated cumulative cancer risk values were developed using Phase I RI data, and COPC-specific risk-based concentrations were developed following completion of Phase I RI activities. Numbers in parentheses are the estimated hazard index values.

[b] Number of samples based on comparison of estimated cancer risk to Table 4-7 in Phase II RI/FS Work Plan, which correlates four cancer-risk categories to the number of samples needed to determine that risk using the project-specific power and confidence limits. For this column, the first number represents sample locations, and the second number (in parentheses) is the number of samples based on an average of three depth intervals per sample location.

[c] These numbers represent the difference between the number of samples required to determine risk and the number of samples collected as part of the Phase I RI, with the following provisions:
Where Phase II RI/FS sample locations were recommended to determine risk, the area covered by this number of locations was based upon the U.S. EPA risk determination standard of a 40- x 40-meter block per sample location. This corresponds to an area of about 206,700 feet^2 for 12 sample locations. If the unit area is greater than this size limit, the maximum specified number of samples, less the Phase I RI number of samples, will be collected during the Phase II RI/FS. If the unit area is less than this size limit, the number of sample locations represents a ratio of the unit area versus the 12-sample area (206,700 feet^2) times 12 (e.g., Site 19, Unit 3: [Unit 3 area/206,700 feet^2]) x 2 locations = 9 locations needed - 3 Phase I locations = 6 new Phase II RI/FS locations required. Use of this ratio rule should maintain the necessary power and confidence limits at units where fewer samples are collected. At units where the ratio rule is applied, the total number of samples (Phase I and Phase II combined) will never be less than six despite the ratio calculation, to be sure that the minimum number of sample locations necessary for a risk assessment is collected. The number of Phase II RI/FS shallow soil boring locations has been based on three samples per location. However, at Site 8 (Unit 3) and Site 12 (Units 1, 2, and 4), four samples per location will be collected.

STEP 7 – OPTIMIZE THE DESIGN

Historic site activities, previous site investigation results, and regulatory comments were used to formulate the Phase II RI/FS sampling approach. Shallow and deeper subsurface soils will be investigated at this site using a tiered sampling approach. This sampling approach consists of three tiers.

- The main focus of the Tier 1 sampling plan will be to determine whether the unit is a risk. The Tier 1 sampling approach will consist of collecting shallow soil samples (less than 10 feet bgs) from a specific number of sampling locations within the unit. The number of sampling locations has been proposed such that when the Phase I and II RI/FS data are evaluated together, an assessment of risk can be completed for the unit.
- The Tier 2 sampling approach will also focus on shallow soil; however, the primary objective will be to refine the extent of shallow soil that has been impacted by site activities, by focusing on subareas of the unit where COPCs exceeded PRGs as identified by the Tier 1 sampling and/or Phase I RI/FS results.
- The Tier 3 sampling approach has been designed to estimate the horizontal and vertical extent of impacted subsurface soil (greater than 10 feet bgs). This sampling strategy will only be implemented if Phase I RI/FS soil sample analytical data or Phase II RI/FS Tier 1/Tier 2 soil sample analytical data suggest impacted soil exists at depths greater than 10 feet bgs. Groundwater will be investigated if Phase I or Phase II soil data indicate potential impacts to groundwater are possible.

The tiered sampling approach is detailed in the following sections and in the FSP, Attachment J (BNI 1995). Table J-2 lists all soil sampling and analysis at Site 10.

Tier 1

The Tier 1 of sampling will be collection of shallow samples from each unit within the site as described below.

TIER 1 SOIL SAMPLING

Tier 1 sample locations within the four units will be positioned using areal systematic random sampling (grid) or judgmental sampling designs to characterize additional areas not sampled as part of the Phase I RI (Figure J-2) and to provide sufficient data to assess risk.

Unit 1: Aircraft Matting Area

The objectives of this investigation are to collect sufficient data to provide additional data on the extent of impacted soil and to support risk assessment.

Table J-2
Soil Sampling and Analysis

Tier	Unit/Name	PHASE II RI/FS SAMPLE NUMBERS			FIELD[a] - IMMUNOASSAY OR MOBILE LABORATORY					OFF-SITE LABORATORY[b]		
		No. of Locations	Samples/ Location	Total Samples	PAH[c]	PCBs[c]	VOCs[d]	TPH[c] Gas and Diesel[d]	Target Analyte List - Metals[d]	PAH	Target Analyte List - Metals	Others:
Tier 1	Unit 1 - Aircraft Matting	8	3	24	X			X				
	Unit 2 - Concrete Apron	10	3	30	X			X				
	Unit 3 - Parking Lot Area	12	3	36	X			X				
	Unit 4 - Parking Area North of Bldg. 1589	2	3	6						X	X	
	Tier 1 Subtotals			96	90			90		6	6	
Tier 2	Optional: Scope of Tier 2 would be to define extent of shallow soil contamination; based on Tier 1 data, Phase I RI findings, and soil gas survey results, with approval of BCT											
Tier 3	Optional: Scope of Tier 3 would be to characterize horizontal and vertical extent of contamination below 10 feet depth; based on Tier 1 and 2 data, Phase I RI findings, soil gas survey results, and/or RFA data, with approval of BCT											

Notes:
- [a] five samples from Unit 1, six samples from Unit 2, and nine samples from Unit 3
- [b] these constituents cannot be determined in the field; all samples to be analyzed for these constituents will be sent to the off-site laboratory
- [c] immunoassay analyses
- [d] mobile laboratory analyses

During the Phase I RI, four locations were sampled in Unit 1. The results of soil sample analysis indicated that benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, indeno(1,2,3-cd)pyrene exceeded PRGs and ecological criteria in shallow soil in Stratum 1. In the Phase II RI/FS, Tier 1 soil samples will be collected at 0, 5, and 10 feet bgs at eight locations based on an areal systematic random sampling designs with a grid spacing of 246 by 307 feet. All soil samples will be field screened for polynuclear aromatic hydrocarbons (PAH) with immunoassay kits (U.S. EPA Method 4035) and TFH (U.S. EPA Method 8015M) using a mobile laboratory. For quality assurance/quality control (QA/QC) support and verification, five samples (four detects and one nondetect) will be submitted to the fixed-base laboratory to confirm field screening results. These fixed-base laboratory analyses are PAH (U.S. EPA Method 8310), and TFH (U.S. EPA Method 8015M) under Naval Facilities Engineering Service Center (NFESC; formerly known as NEESA) Level D protocols. Attachment J in the FSP provides the sampling procedures for the Phase II RI/FS at Site 10, Unit 1 (BNI 1995).

Unit 2: Concrete Apron Area

The objectives of this investigation are to collect sufficient data to provide additional data on the extent of impacted soil, confirm Phase I RI results and support risk assessment.

During the Phase I RI, four locations were sampled in Unit 2. The results of soil sample analysis indicated that no COPCs were detected in shallow soil in Stratum 2 exceeded PRGs or ecological screening criteria. In addition, the soil gas survey did not indicate the presence of VOC or TFH in Unit 2. In the Phase II RI/FS, Tier 1 soil samples will be collected at 0, 5, and 10 feet bgs at 10 locations based on an areal systematic random sampling design using a grid spacing of 198 by 180 feet. All soil samples will be field screened for PAH with immunoassay kits (U.S. EPA Method 4035) and for TFH (U.S. EPA Method 8015M) using a mobile laboratory. For QA/QC support and verification, six samples (four detects and two nondetects) will be submitted to the fixed-base laboratory to confirm field screening results. These fixed-base analyses are PAH (U.S. EPA Method 8310) and TFH (U.S. EPA Method 8015M) under NFESC Level D protocols. Attachment J in the FSP provides the sampling procedures for the Phase II RI/FS at Site 10, Unit 2 (BNI 1995).

Unit 3: South Parking Area

The objectives of this investigation are to collect sufficient data to characterize the unit, support NFI recommendation or selection of a remedial; alternative, and support risk assessment.

During the Phase I RI no locations were sampled in Unit 3. In the Phase II RI/FS, Tier 1 soil samples will be collected at 0, 5, and 10 feet bgs at 12 locations based on an areal systematic random sampling design using a grid spacing of 155 by 151 feet. All soil samples will be field screened for PAH with immunoassay kits (U.S. EPA Method 4035) and for total petroleum hydrocarbons (TPH) (U.S. EPA Method 8015M) using a mobile laboratory. For QA/QC support and verification, nine samples (six detects and three nondetects) will be submitted to the fixed-base laboratory to confirm field screening results. These fixed-base analyses are PAH (U.S. EPA Method 8310) and TPH (U.S. EPA Method 8015M) under NFESC Level D protocols. Attachment J in the FSP provides the sampling procedures for the Phase II RI/FS at Site 10, Unit 3 (BNI 1995).

Unit 4: Parking Area North of Building 1589

The objectives of this investigation are to collect sufficient data to characterize the unit, support NFI recommendation or selection of a remedial; alternative, and support risk assessment.

During the Phase I RI no locations were sampled in Unit 4. In the Phase II RI, Tier 1 soil samples will be collected at 0, 5, and 10 feet bgs at two judgmental sample locations to characterize the areas where waste products were stored prior to being sprayed for dust control over the area of Site 10. One sample location will be adjacent to the northwest side of Building 1589, and one sample location will be adjacent to the northeast of Building 1589. All soil samples will be submitted to the fixed-base laboratory for chemical analyses. These fixed-base analyses are PAH (U.S. EPA Method 8310), TPH (U.S. EPA Method 8015M), and TAL metals (U.S. EPA Method 6000/7000) under NFESC Level D protocols. Attachment J in the FSP provides the sampling procedures for the Phase II RI/FS at Site 10, Unit 4 (BNI 1995).

Tier 2

The primary objective of the Tier 2 sampling program is to refine the extent of impacted soil identified within each unit by Phase I and/or II RI/FS sampling results. The Tier 2 sampling program will focus exclusively on shallow soil (0 to 10 feet depth) conditions and will further investigate subareas within the unit boundary that exceed PRGs.

The Tier 2 sampling plan will be developed after an evaluation of Phase I RI/FS and/or Phase II RI Tier 1 analytical results. If a Tier 2 sampling program meets the DQOs for this unit, the decision to proceed will be based upon the criteria described in DQO Steps 2, 3, and 5. The proposed Tier 2 sampling plan, with recommendations, will be reviewed by the Base Realignment and Closure (BRAC) Cleanup Team (BCT). The BCT will decide whether the proposed Tier 2 sampling program will be implemented by the Navy.

TIER 2 SOIL SAMPLING

As noted, the objective of a Tier 2 sampling program is to refine the extent of impacted shallow soil within the unit being investigated. The rationale for accomplishing this objective depends primarily on the size and layout of the unit. Where the unit is a linear feature such as a drainage ditch, the Tier 2 program will focus sampling along the trend of the ditch bracketing the Tier 1 sampling locations (or Phase I RI/FS sample locations) where analyte concentrations exceeding PRGs are reported.

For units of rectangular, roughly circular, or irregular dimensions, a systematic random sampling based on a grid, stratified random sampling, or judgmental sampling approach will be used to define the extent of the Tier 1 sample location(s) where analyte concentrations exceeded PRGs. The limits of the area covered by these sampling approaches will be contingent upon the distribution of adjacent Tier 1 sample locations in which the COPCs were not detected.

The number of Tier 2 sampling locations (i.e., grid spacing) will be selected to achieve the following objectives:

- provide the areal coverage necessary to define the extent of shallow impacted soil; and
- minimize the cost associated with field and fixed-base laboratory sample testing.

The spacing between sampling locations for Tier 2 will be contingent upon the estimated size of the area to be investigated and the spacing between Phase I or II RI/FS sample locations. Tier 2 soil sample depth intervals and chemical analyses will conform to those specified for Tier 1 soil sampling.

Tier 3

The Tier 3 sampling program would only be implemented at a unit where Phase I RI data, or the initial evaluation of the Phase II RI Tier 1 and/or Tier 2 sampling program results suggest that soil contamination may extend to depths greater than 10 feet bgs.

The objectives of the Tier 3 sampling program are to estimate the horizontal and vertical extent of impacted subsurface soil (greater than 10 feet bgs) and assess whether groundwater beneath the site has been impacted by historic site activities. If impacted subsurface soil is limited to the vadose zone above the water table or vadose zone modeling does not suggest a potential for COPCs to impact groundwater, then groundwater quality will not be investigated.

The Tier 3 sampling plan will be developed after an evaluation of Phase I RI/FS and Phase II RI Tier 1 and/or 2 analytical results. If a Tier 3 sampling program meets the DQO for this unit, then the decision to proceed will be based upon the criteria described in DQO Steps 2, 3, and 5. The proposed Tier 3 sampling plan, with recommendations, will be reviewed by the BCT. The BCT will decide whether the proposed Tier 3 sampling program will be implemented.

Optimization of Sampling Plan

As soil analytical data become available from sampling in each unit, investigative plans for the site will be optimized. The proposed tiered sampling approach is an iterative process that will permit data from one tier to be evaluated prior to the implementation of the next tier of sampling. The iterative process involves review of data, recommendations for further actions, and approval of the BCT. In this way, the investigation can be optimized by performing the least amount of sampling necessary to assist the decision making process about future actions at the unit (i.e., NFI, Early Action, and Long-Term Action).

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WORK PLAN APPENDIX K

DATA QUALITY OBJECTIVES
OPERABLE UNIT 3 –
SITE 11 – TRANSFORMER STORAGE AREA

Summary

STEP 1 – STATE THE PROBLEM

Site 11, the Transformer Storage Area, was a maintenance and storage yard for electrical transformers. The site is a fenced storage yard that comprises three areas: 1) a concrete pad northeast of Building 369; 2) an asphalt-lined drainage ditch running parallel to Building 369 extending from the concrete pad to N Street; and 3) a fenced storage yard north of Building 369. Shallow soil beneath Site 11 is contaminated with polychlorinated biphenyls that were associated with the transformer storage.

Available information suggests that the contaminated soil may be limited to the shallow soil interval at depths of less than 10 feet below ground surface. The human health and ecological risks associated with the contaminated soil will be estimated so that a No Further Investigation, Removal Action, or the appropriate remedial alternative can be recommended.

STEP 2 – IDENTIFY THE DECISION

The Phase II Remedial Investigation/Feasibility Study decision to be considered at Site 11 is as follows: Do chemicals of potential concern in the shallow soil at Site 11 present an unacceptable risk to human health and the environment? The possible decision outcomes are recommendations for No Further Investigation, Early Action, or Long-Term Action.

STEP 3 – IDENTIFY THE INPUTS AFFECTING THE DECISION

Inputs necessary to make these decisions are a list of chemicals of potential concern; extent of impacted media; background concentrations of metals, herbicides, and pesticides; and action levels for protection of human health and the environment.

STEP 4 – DEFINE THE BOUNDARIES OF THE STUDY

The study is limited to three areas: 1) the concrete pad (approximately 960 square feet) to the north of Building 369; 2) the drainage ditch (approximately 710 square feet), which is asphalt-lined and runs parallel to Building 369; and 3) the storage yard (approximately 27,800 square feet) to the north of Building 369, which was added to Site 11 for the Phase II Remedial Investigation/Feasibility Study.

STEP 5 – DEVELOP A DECISION RULE

Actions levels developed for decision-making purposes are a cumulative excess cancer risk of 10^{-6} in humans and a hazard index of 1.0 for chronic systemic toxicity in humans. Based on these risk levels, decision rules have been formulated to protect human health and the environment in residential, recreational, and industrial land use scenarios.

STEP 6 – SPECIFY LIMITS ON UNCERTAINTY

The number of samples necessary to estimate different levels of risk were calculated using the confidence level of 95 percent and power level of 80 percent limits specified for this project. The preliminary cancer and noncancer risk values were compared to the risk

levels, and the appropriate number of samples necessary to estimate risk were selected for each unit.

STEP 7 – OPTIMIZE THE DESIGN

Shallow soil samples will be collected and analyzed at 0, 2, and 4 feet below ground surface at six locations in the storage yard area to assess contaminated soils in these areas and to support the risk assessment.

ACRONYMS/ABBREVIATIONS

ARAR	applicable or relevant and appropriate requirement
BCT	BRAC Cleanup Team
bgs	below ground surface
BRAC	Base Realignment and Closure
COPC	chemical of potential concern
DDD	dichlorodiphenyldichloroethane
DDE	dichlorodiphenyldichloroethene
DDT	dichlorodiphenyltrichloroethane
DQO	data quality objective
EE/CA	Engineering Evaluation/Cost Analysis
FS	Feasibility Study
FSP	Field Sampling Plan
MCAS	Marine Corps Air Station
µg/kg	micrograms per kilogram
mg/kg	milligrams per kilogram
NEESA	Naval Energy and Environmental Support Activity
NFESC	Naval Facilities Engineering Service Center
NFI	No Further Investigation
PCB	polychlorinated biphenyl
PRG	(U.S. EPA Region IX) Preliminary Remediation Goal
RI	Remedial Investigation
RI/FS	Remedial Investigation/Feasibility Study
SAIC	Science Applications International Corporation
U.S. EPA	United States Environmental Protection Agency
UST	underground storage tank

ACRONYMS/ABBREVIATIONS (continued)

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Appendix K
SITE 11 – TRANSFORMER STORAGE AREA

The United States Environmental Protection Agency (U.S. EPA) developed the data quality objectives (DQO) process as a tool for project managers to determine the type, quantity, and quality of data needed to make decisions. Data produced by sampling and monitoring activities are used extensively in problem definition, rule-making, and enforcement decisions. These activities are supported through implementation of the mandatory U.S. EPA Quality System, which requires all organizations to develop and operate management processes and structures for assuring that the data collected are of the necessary and expected quality for their desired use (U.S. EPA 1993).

The U.S. EPA DQO process consists of the following seven steps.

1. **State the problem:** Describe the problem at the site as it is currently understood. The problem statement includes a site conceptual model and an organization and review of all relevant data.
2. **Identify the decision:** Determine an if-then statement that will define what the investigation will seek to determine and what actions will be taken based on the possible outcomes of the investigation.
3. **Identify inputs into the decision:** Specify the analytes or parameters to be measured and used.
4. **Define the study boundary:** Delineate the study boundary from information obtained from Step 1.
5. **Develop a decision rule:** Restate the decision detailing the if-then statement in specific terms.
6. **Specify acceptable limits on decision errors:** Specify how the data will be treated statistically and what the acceptable limits of uncertainty are.
7. **Optimize the design:** Design the field investigation, giving adequate consideration to the results of Steps 5 and 6. This step is described in more detail in the Field Sampling Plan (FSP).

The following sections describe the DQO process for Site 11 – Transformer Storage Area.

STEP 1 – STATE THE PROBLEM

Site 11 was previously used for maintenance and storage of electrical transformers. Shallow soils beneath Site 11 are contaminated with polychlorinated biphenyls (PCB).

Site Description

Site 11, the Transformer Storage Area, is located on the northeast side of Building 369 in the western quadrant of Marine Corps Air Station (MCAS) El Toro (Figure K-1). The site is a fenced storage yard and comprises three subareas: a concrete pad (approximately 30 by 30 feet) and the area surrounding it located northeast of Building 369; an asphalt-lined drainage ditch that parallels the north side of Building 369, extending from the concrete pad to N Street; and a fenced storage yard to the north of Building 369 (Figure K-2). Site boundaries for MCAS El Toro Phase I Remedial Investigation (RI) were determined by consensus between the Navy and regulatory agencies prior to initiation of the Phase I RI. Areas of concern were generally grouped together into sites based on common historical activities, aerial photograph review, and their respective locations to each other.

Site 11 was a maintenance and storage yard for transformers. Most of the storage yard is relatively flat and covered with gravel. A wide, shallow depression is located in center of the yard and appears to receive drainage from the concrete pad northeast of Building 369. Staining was evident in the depression during the Phase I RI (Jacobs Engineering 1993a).

Site 11 was utilized for storage of 50 to 75 transformers from approximately 1968 to 1983. Reportedly, five transformers leaked, and one spilled an estimated 60 gallons of PCB transformer oil onto the concrete pad. The transformer oil was believed to have migrated to the edge of the pad and discharged onto the unlined surface of the storage yard and into the drainage ditch parallel to Building 369. A catch basin that discharges into Bee Canyon Wash is located west of Building 369. The catch basin receives runoff from a wide area. It was not known where on the pad the leakage occurred. In 1983, the transformers were removed and disposed off-site (Jacobs Engineering 1993a).

Previous Investigations

Several investigations have been conducted in the area of Site 11: the Phase I RI, aerial photograph surveys, and employee interviews. The sections below provide a summary of these investigations.

PHASE I REMEDIAL INVESTIGATION

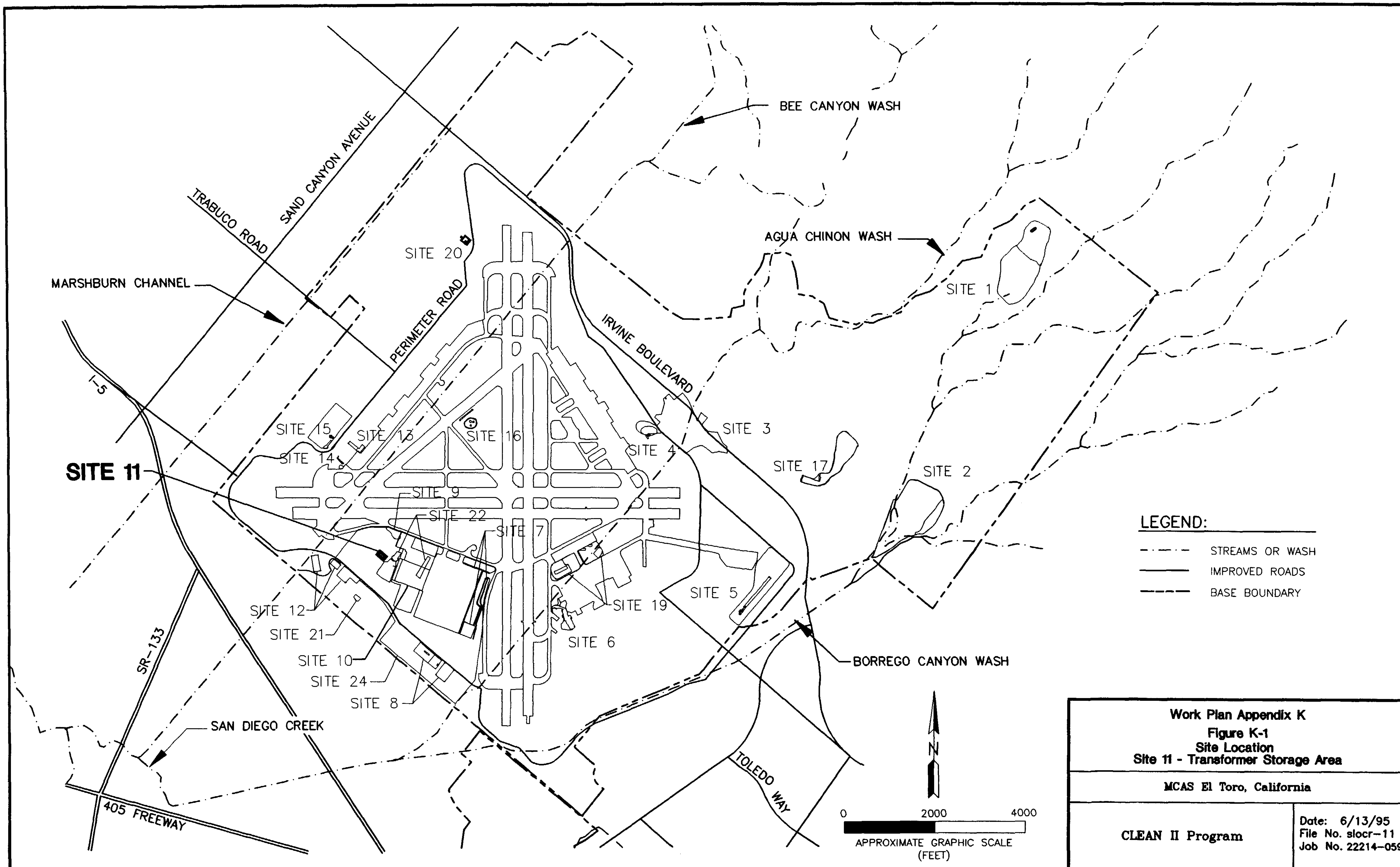
For the Phase I RI, subareas within sites were designated as strata. Due to the fact that some new subareas have been added or subareas have been expanded or diminished for the Phase II RI/Feasibility Study (FS), subareas within sites will be referred to as units for the Phase II RI/FS. In this section, discussion is related to Phase I RI sampling and results, and the term strata will be used. Following this section, the term unit will be used.

For the Phase I RI, Site 11 was represented by two strata (Figure K-2):

- Stratum 1 – the Concrete Pad and surrounding area; and
- Stratum 2 – the Asphalt-Lined Drainage Ditch running parallel to Building 369.

The following site-specific activities were conducted:

- sixteen shallow soil samples (0 to 4 feet below ground surface [bgs]) were collected at six locations (three in each stratum); and
- soil samples were analyzed for pesticides/ PCB.


BEE CANYON WASH
AGUA CHINON WASH
SAND CANYON AVENUE
TRABUCO ROAD
MARSHBURN CHANNEL
PERIMETER ROAD
IRVINE BOULEVARD
I-5
SR-133
405 FREEWAY
TOLEDO WAY
SAN DIEGO CREEK
BORREGO CANYON WASH
SITE 1
SITE 2
SITE 3
SITE 4
SITE 5
SITE 6
SITE 7
SITE 8
SITE 9
SITE 10
SITE 11
SITE 12
SITE 13
SITE 14
SITE 15
SITE 16
SITE 17
SITE 19
SITE 20
SITE 21
SITE 22
SITE 24
LEGEND:
STREAMS OR WASH
IMPROVED ROADS
BASE BOUNDARY
N
0
2000
4000
APPROXIMATE GRAPHIC SCALE
(FEET)
Work Plan Appendix K
Figure K-1
Site Location
Site 11 - Transformer Storage Area
MCAS El Toro, California
CLEAN II Program
Date: 6/13/95
File No. slocr-11
Job No. 22214-059

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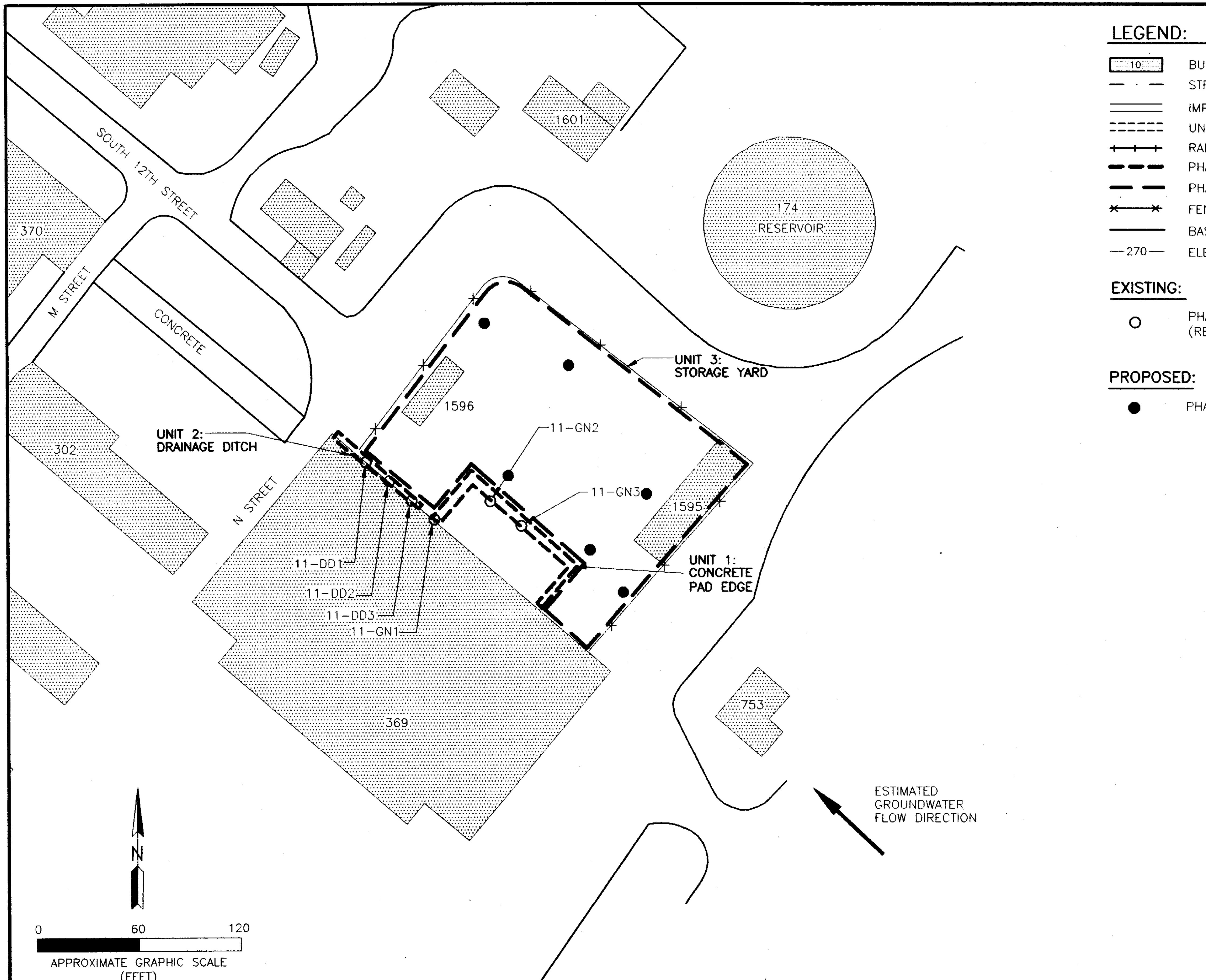

Work Plan Appendix K

Figure K-2
Site Plan
Site 11 - Transformer Storage Area

MCAS El Toro, California

CLEAN II Program

Date: 7/6/95
File No. siter11
Job No. 22214-059

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The ranges of analyte concentrations detected during the Phase I RI are summarized below (sample identification of the highest concentrations is provided). If a minimum concentration is recorded with a "less than" symbol, this denotes a concentration below the contract laboratory program detection limit. Sample locations are shown on Figure K-2. Data were obtained from the Phase I RI Technical Memorandum (Jacobs Engineering 1993a), Appendix B-11, and Table B11-2:

Shallow Soil (< 10 feet below ground surface)

- PCB and pesticides: 4,4'-dichlorodiphenyldichloroethane (DDD) (< 3.59 to 137 micrograms per kilogram [μg/kg] [11_DD3 at 2 feet]), 4,4'-dichlorodiphenyldichloroethene (DDE) (< 3.59 to 3.76 μg/kg [11_GN2 at 2 feet]), 4,4'-dichlorodiphenyltrichloroethane (DDT) (< 3.59 to 105 μg/kg [11_GNI at 0 feet]), endosulfan II (< 3.59 to 134 μg/kg [11_GN1 at 0 feet]), endrin aldehyde (< 3.59 to 145 μg/kg [11_DD1 at 4 feet]), endrin (< 3.59 to 24.9 μg/kg [11_DD1 at 4 feet]), and PCB (Aroclor 1260) (< 35.9 to 4,960 μg/kg [11_GN1 at 0 feet]).

Shallow soil samples were only analyzed for pesticides and PCB. No subsurface soil (deeper than 10 feet bgs) or groundwater samples were collected from Site 11, because these chemicals of potential concern (COPCs) (PCBs) do not readily migrate vertically into these media.

U.S. EPA Region IX Preliminary Remediation Goals (PRGs) and ecological screening criteria for the site were compared with corresponding soil sample analytical results. The results of this comparison are summarized below (Jacobs Engineering 1993a, pages A11-6 and A11-7):

- Aroclor 1260 exceeds PRGs in Strata 1 and 2; and
- no COPCs exceed ecological screening criteria in either strata.

U.S. EPA AERIAL PHOTOGRAPH SURVEY

The first indication of transformer storage at Site 11 was observed in the 1965 photograph. This photograph also revealed a possible stain in the center of the storage yard. The 1991 photograph shows a possible vertical tank and a flowing liquid/stain as being present on the northwestern portion of the concrete pad (Jacobs Engineering 1993a).

SCIENCE APPLICATIONS INTERNATIONAL CORPORATION AERIAL PHOTOGRAPH SURVEY

The Science Applications International Corporation survey noted a probable vertical tank in the storage yard on the 1987 photo. Probable stains were observed in the center of the storage yard in the 1992 photo. It is unclear whether these features are identical to the ones on the 1991 U.S. EPA photo (SAIC 1993).

EMPLOYEE INTERVIEWS

On 26 May 1994 a meeting was held at MCAS El Toro to interview active and retired personnel from the Station Fuel Operations Division and Facility Management Department (currently the Installations Department) who had knowledge of the Station operations and procedures for the storage/disposal of hazardous materials and waste. Participating as interviewers during the meeting were agency personnel, Navy and Station personnel, and personnel contractors for the Navy and U.S. EPA. During these interviews the following information pertaining to Site 11 was obtained (Jacobs Engineering 1994).

- The dirt lot behind Building 369 was used to store equipment that needed repair. Many transformers were refilled with PCB oil at this location. An estimated 4 to 10 gallons per year of PCB oils were spilled onto the ground surface.
- On 29 September 1982, one transformer fell off a truck between Buildings 369 and 335, and spilled about 5 gallons of PCB-containing fluid onto the asphalt surface. The impacted asphalt was removed, along with the top 18 inches of soil beneath the asphalt. The excavated material was disposed into the Station landfill (Jacobs Engineering 1994).

Geology

The geology of Site 11 consists of Quaternary alluvial and marine deposits (Jacobs Engineering 1993a). Holocene deposits consist of fine-grained overbank deposits and some coarse-grained stream channel deposits. These soils are derived from the Santa Ana Mountains to the east and conformably overlie Pleistocene interbedded fine-grained lagoonal and near-shore marine deposits. Pleistocene deposits could not be differentiated from Holocene deposits in Phase I RI soil borings. Pleistocene deposits unconformably overlie semiconsolidated marine sandstones, siltstones, and conglomerates of late Miocene to late Pliocene, which are considered to be bedrock in the area.

Based on a review of boring logs from the Phase I RI, the subsurface lithology at Site 11 consists of well graded to silty sand that is interbedded with silt and clay. Occasional gravel lenses may exist within the sand units, which would probably be associated with stream channels.

Hydrogeology

MCAS El Toro lies within the Irvine Groundwater Basin, which is a subbasin of the Los Angeles groundwater basin. Regional aquifers in the Irvine Subbasin tend to be composed of discontinuous lenses of clayey and silty sands and fine-grained gravels contained within a complex assemblage of sandy clays and sandy silts. Three general aquifer systems have been identified near the Station: a shallow and perched system, a principal aquifer zone, and a lower hydrogeologic system existing in bedrock (Jacobs Engineering 1993a).

Groundwater is not being investigated as part of the Phase II RI/FS for Site 11. However, based on monitoring wells adjacent to the site, the shallow, perched zone is probably not present at Site 11, and groundwater is at a depth of approximately 100 feet bgs. The regional groundwater flow direction in the area of the site is generally to the northwest. The hydraulic gradient in the area of the site has been influenced strongly by the pumping of irrigation wells located west of MCAS El Toro.

Conceptual Site Model

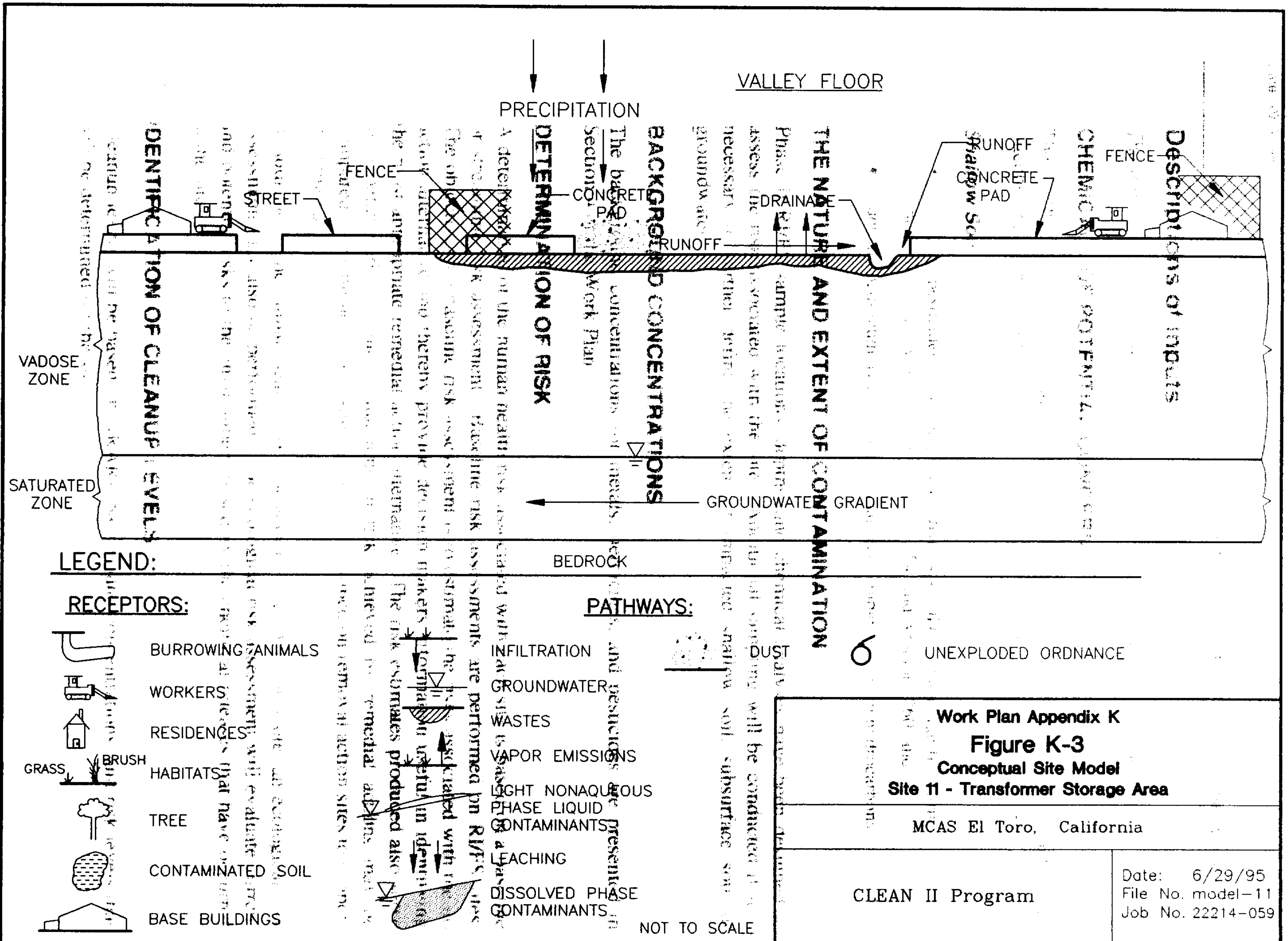
In the process of developing a conceptual site model, release mechanisms and potential sources of contamination were considered and evaluated to determine their applicability to the site. Also considered in the development of the conceptual site model were potential receptors and contaminant pathways to potential receptors. Figure K-3 illustrates the conceptual site model developed for the site. Figure K-4 depicts the potential exposure routes and pathways for human and ecological receptors.

The primary release mechanism is contaminants released to shallow soil from disposal activities at this site. Eventually under gravity, contaminants present in shallow soil may move downward with soil moisture (in a dissolved phase) or in a liquid phase. The depth of groundwater is estimated to be about 120 feet bgs.

The secondary source of contaminants is the surrounding soil impacted by disposal activities. One secondary release mechanism is the dust brought into suspension in the air by wind. The fine particles of dust may contain all potential contaminants. Storm water runoff may form another secondary release mechanism. Storm water carries contaminants in dissolved forms, colloidal forms, or forms associated with suspended soil particles.

The potential pathways are air, groundwater, and surface water. Airborne contaminants are transported through fugitive dust and volatilization. The transport through air is affected by wind speed and direction, type of contaminant, and weather condition. Typically, wind at MCAS El Toro is from west/southwest at less than 10 knots. Transportation of airborne contaminants through volatilization is expected to be unimportant at this site. Surface water transport is affected by the amount of rainfall, type of contaminant, surface soil properties, and the topography of the area. The mean annual rainfall at MCAS El Toro is about 14.0 inches, most of which occurs from November through April.

Current and/or potential receptors of chemicals at this site via inhalation are workers and visitors involved in disposal activities. Direct contact with surface and subsurface soils is currently possible via dermal or ingestion exposures of terrestrials. Infiltration of contaminated water through the vadose zone into groundwater is possible because subsurface soil is mainly sands, with some silts and clays. However, current exposure of workers is unlikely via ingestion of groundwater at this site.



Work Plan Appendix K

Figure K-3

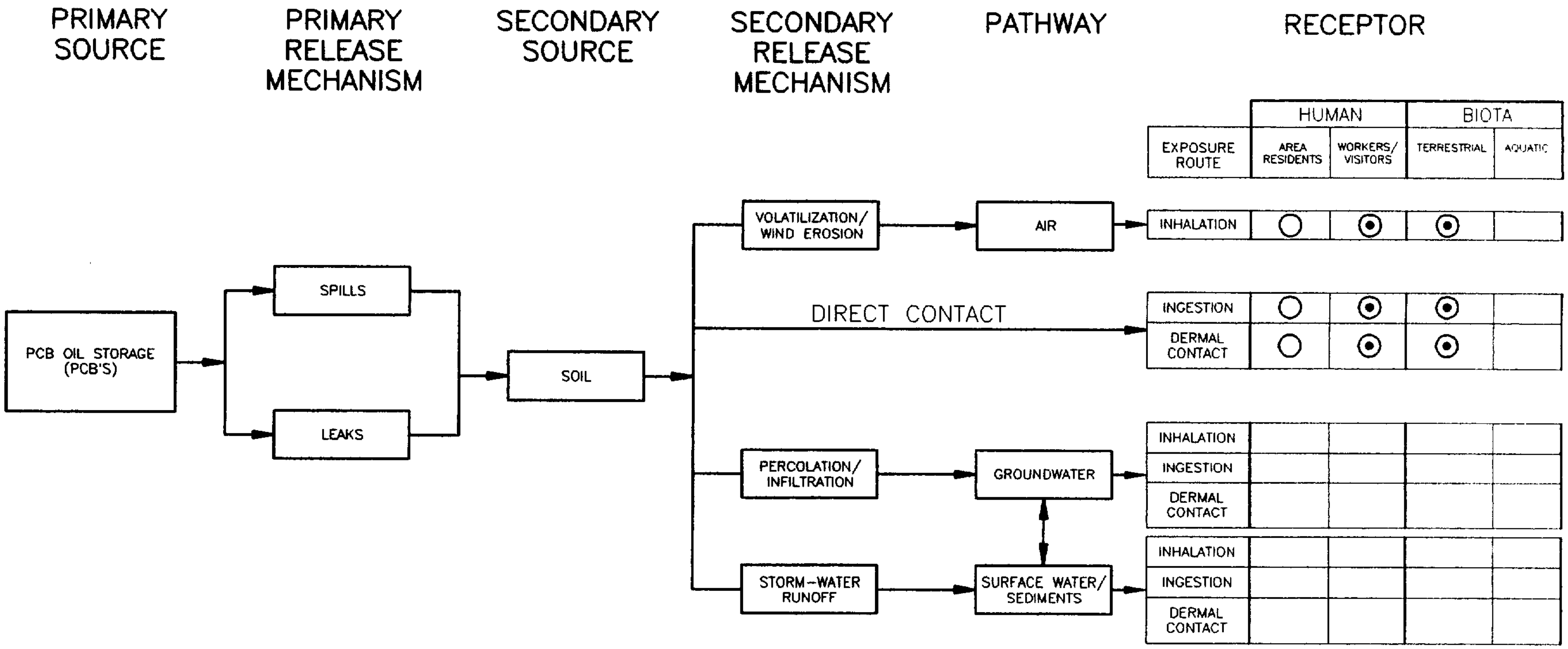
Conceptual Site Model

Site 11 - Transformer Storage Area

MCAS El Toro, California

CLEAN II Program

Date: 6/29/95
File No. model-11
Job No. 22214-059



LEGEND:

● CURRENT POTENTIAL RECEPTOR

○ FUTURE POTENTIAL RECEPTOR

Work Plan Appendix K

Figure K-4

Exposure Routes and Receptors
Site 11 - Transformer Storage Area

MCAS El Toro, California

CLEAN II Program

Date: 6/28/95
File No. mod11
Job No. 22214-059

Terrestrial wildlife could be exposed to chemicals in on-site surface soil, and dust and vapors through ingestion, dermal absorption, or inhalation. Terrestrial plants could also be exposed through root absorption of chemicals in surface soil or deposition of dusts. No special-status species were observed at this site, and the immediate area provides marginal habitat for wildlife species.

Statement of Phase II RI/FS Problem

Site 11, the Transformer Storage Area, is located on the northeast side of Building 369 in the western quadrant of MCAS El Toro. The problems associated with this site are the following:

- shallow soil at Site 11 is impacted with PCB;
- shallow soil in the transformer storage yard needs to be assessed; and
- more data are necessary to calculate a cumulative excess cancer risk and hazard index, and assess further action for the site.

STEP 2 – IDENTIFY THE DECISION

This step describes the decisions that will be considered during the DQO process for Site 11. For each decision, the alternative outcomes are stated. The Sampling Decision Process is illustrated on Figure K-5. For Site 11, the following decisions will be considered:

1. Do COPCs in shallow soil (less than 10 feet bgs) in the unit exceed established background concentrations and PRGs, and/or do they present an unacceptable risk to human health or the environment?

   If yes, proceed to the next decision.

   If uncertain, collect additional soil samples to determine.

   If no, recommend the unit for No Further Investigation (NFI).

2. Has the extent of impacted soil been defined in the shallow soil?

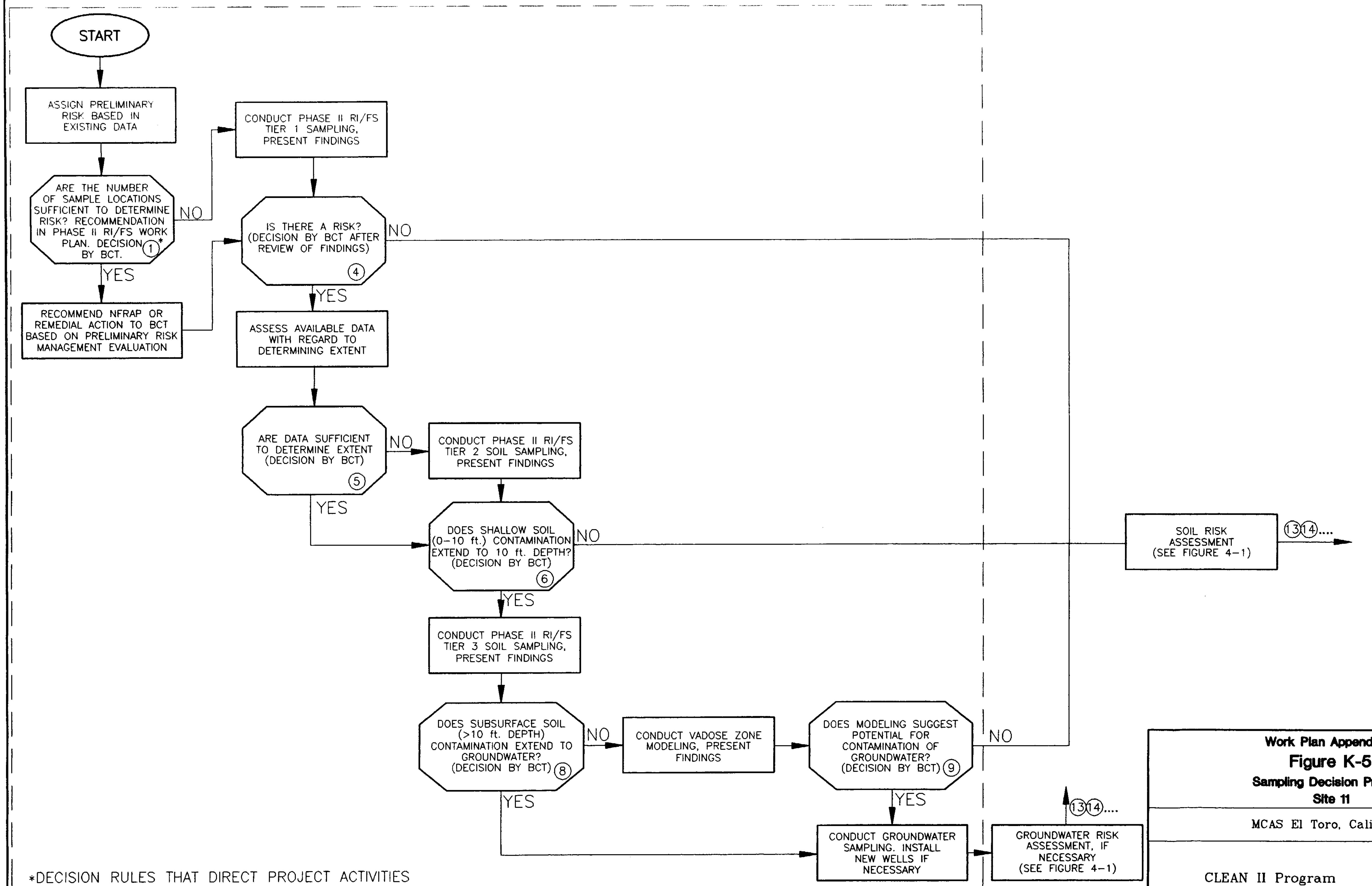
   If yes, evaluate a response action.

   If no, conduct soil sampling to define extent.

3. Does the extent of impacted shallow soil extend into the subsurface (greater than 10 feet bgs)?

   If yes, conduct soil sampling to define vertical extent of impacted soil, and if necessary, evaluate potential impacts to groundwater beneath the site.

   If no, evaluate a response action.



Work Plan Appendix K

Figure K-5

Sampling Decision Process
Site 11

MCAS El Toro, California

CLEAN II Program

Date: 3/11/95
File No. Logicr11
Job No. 22214-059

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4. Do the media being evaluated for a response action qualify for Early Action?

   If yes, recommend unit for an Engineering Evaluation/Cost Analysis (EE/CA).

   If no, recommend unit for a remedial response as part of the RI/FS process.

STEP 3 – IDENTIFY THE INPUT AFFECTING THE DECISION

Step 2 defined the decisions addressing possible actions at the site. Step 3 will identify the inputs that are required to assess the actions as discussed below:

Inputs for No Further Investigation

Input information required to support a NFI recommendation will also be used to support decisions for Early Action and Long-Term Action. These inputs are as follows:

- list of COPCs;
- definition of the extent of impacted soil;
- background concentrations for metals, pesticides, and herbicides;
- determination of risk for the unit; and
- action levels for the protection of human health and the environment.

Inputs for Early Action

In addition to the inputs required for a NFI recommendation, input information required to support a Early Action recommendation will include the following:

- applicable or relevant and appropriate requirements (ARARs);
- identification of cleanup standards;
- identification of cleanup technology applicability/limitations that are not extensive operation and maintenance activities; and
- site/unit cleanup in less than 5 years.

Inputs for Long-Term Action

In addition to the inputs required for a NFI recommendation, input information required to support a Long-Term Action recommendation may include the following:

- ARARs;
- identification of cleanup standards;
- identification of cleanup technology applicability/limitations;
- pilot testing of remedial alternatives; and
- site/unit cleanup in more than 5 years.

Descriptions of Inputs

The following subsections discuss the inputs required to assess possible response actions.

CHEMICALS OF POTENTIAL CONCERN

The COPCs for Site 11 include all chemicals detected in the Phase I RI for each media (Jacobs Engineering 1993b, page A11-4). COPCs for Site 11 are listed below.

Shallow Soil

- PCB and pesticides: 4,4'-DDD, 4,4'-DDE, 4,4'-DDT, endosulfan II, endrin, endrin aldehyde, Aroclor 1248, Aroclor 1254, and Aroclor 1260; and
- fuel and petroleum hydrocarbons: total recoverable petroleum hydrocarbons.

THE NATURE AND EXTENT OF CONTAMINATION

Phase II RI/FS sample locations, depths, and chemical analyses have been designed to assess the risk associated with the site. Additional sampling will be conducted if it is necessary to further define the extent of impacted shallow soil, subsurface soil, or groundwater.

BACKGROUND CONCENTRATIONS

The background concentrations for metals, herbicides, and pesticides are presented in Section 4 of the Work Plan.

DETERMINATION OF RISK

A determination of the human health risk associated with each site is based on a baseline or streamline risk assessment. Baseline risk assessments are performed on RI/FS sites. The objective of a baseline risk assessment is to estimate the risks associated with the no action alternative and thereby provide decision makers information useful in identifying the most appropriate remedial action alternative. The risk estimates produced also serve as a benchmark to which reductions in risk achieved by remedial actions may be compared. Streamlined risk assessments are performed on removal action sites to support the removal action.

In addition to the human health risk assessment conducted for a site, an ecological risk assessment may also be performed. The ecological risk assessment will evaluate current and potential risks to the environment posed by the chemical releases that have occurred at the sites.

IDENTIFICATION OF CLEANUP LEVELS

Cleanup levels will be based on ARARs, background concentrations, and risk levels that will be determined for the site.

CLEANUP TECHNOLOGY EFFECTIVENESS, IMPLEMENTABILITY, AND COSTS

Once cleanup levels have been established, the most appropriate and cost-effective approach will be identified to remediate the site, if necessary.

STEP 4 – DEFINE THE BOUNDARIES OF THE STUDY

This step defines the spatial and temporal boundaries of the problem and any practical constraints that may interfere with the study.

- Unit 1 – Concrete Pad (approximately 960 feet^2), boundaries consist of the edge of the concrete pad located north of Building 369. This unit has the same boundaries as Phase I RI, Site 11, Stratum 1.
- Unit 2 – Drainage Ditch (approximately 710 feet^2), the asphalt-lined drainage ditch running parallel to Building 369. This unit has the same boundaries as Phase I RI, Site 11 Stratum 2.
- Unit 3 – Storage Yard (approximately 27,800 feet^2), created for the Phase II RI to investigate the storage yard north of Building 369 where transformers were stored.

Specification of temporal boundaries for the field sampling activities is unnecessary. Shallow and deeper subsurface soil conditions are not considered to be significantly different from conditions during the Phase I RI sampling or throughout the period since spillage or unregulated waste disposal activities occurred on the site.

STEP 5 – DEVELOP A DECISION RULE

Decision rules are required to state explicitly the types of inputs and logical basis for choosing among alternative actions during the Phase II RI/FS. A list of all decision rules for the project are included in Section 4 of the Work Plan. The specific decision rules that will be followed to determine an action are presented here. These decision rules conform to the numbering sequence presented in Section 4 of the Work Plan.

2. If Phase I data are sufficient to assess a response action to reduce risk associated with site units which exceed media action levels or background concentrations, then the cleanup levels and appropriate response action (Early Action or Long-Term Action) will be determined.
3. If Phase I data are not sufficient to assess whether risks are present based on the minimum number of samples, then Tier 1 sampling of the Phase II RI/FS will be completed to supplement the Phase I analytical results so the minimum number of samples is satisfied to assess whether action levels or background concentrations are exceeded in site units.
4. If Phase I data and Tier I data for the Phase II RI/FS indicate that no solid wastes are exposed and respective action levels or background concentrations for the various media of a site unit are not exceeded, then NFI will be recommended.

5. If Phase I data or Tier 1 data of the Phase II RI/FS combined with Phase I data exceed PRGs, action levels, or background concentrations for the various media, then Tier 2 of the Phase II RI/FS sampling and analyses will be conducted to define horizontal and vertical extent, provided additional sampling costs are not more than a potential response action.

6. If PRGs, action levels, or background concentrations for shallow soil are exceeded, and if COPCs detected in the soil extend to 10 feet bgs, then soil below 10 feet bgs (subsurface soil) will be investigated to assess the horizontal and vertical extent of the COPCs.

7. If during the investigation of COPCs in subsurface soil, two consecutive soil sample analyses (at a minimum 5-foot-depth separation) demonstrate that COPCs are not detected, then the vertical extent of soil contamination will be established and investigation of subsurface soil will be halted at that location. The horizontal extent will be established when COPCs are not detected in vertical samples taken at three locations around the sample that exceeds the action levels.

   The lowest detection limit available will be used to define the base of a contaminant plume. COPC detection or quantitation limits that will be compared to establish the base of the contaminant plume include the following:

   - contract-required detection limit,
   - contract-required quantitation limit,
   - sample quantitation limit,
   - estimated quantitation limit,
   - practical quantitation limit,
   - method detection limit, and
   - instrument detection limit .

8. If during the investigation of COPCs in subsurface soil, it is determined by actual sampling that COPCs extend to the water table, groundwater beneath the site will be investigated for the presence of the COPCs.

9. If COPCs are identified in subsurface soil below 10 feet bgs, above background and action levels, but do not extend to the water table, then vadose zone computer modeling will be used to evaluate the potential for the COPCs to impact groundwater.

10. If it is determined that COPCs in subsurface soil have impacted groundwater causing exceedance of action levels, then the vertical and horizontal extent of groundwater exceedance will be evaluated.

13. If action levels or background concentrations are exceeded for the media of a site unit, then the risk assessment will be initiated, based on sample results, acceptable levels of risk, and potential land uses, to assess potential risks to human health and/or the environment.

14. If unacceptable risks are assessed to human health or the environment, then cleanup levels will be evaluated for each media.
15. If cleanup levels in a given medium are exceeded, and if the site meets at least one of the eight criteria for removal action described in 40 *Code of Federal Regulations* 300.415(b)(2), and the scale and complexity of contaminant distribution in the affected medium are such that excess risk can be expediently reduced utilizing readily available technology, then the medium at the site will be recommended for Early Action.
16. If an early removal action is selected, a non-time-critical EE/CA and Action Memorandum will be completed for the removal action.
17. Once the removal action is completed, the site will be evaluated for residual risk. If a residual risk exists, then a Long-Term Action may be required.
18. If cleanup levels for a given medium are exceeded, and if the site does not meet criteria for an Early Action, then the affected medium will be recommended for long-term remedial action as part of the RI/FS process; and an FS will be completed, followed by a Record of Decision, Remedial Design, and Remedial Action to clean up the site for closure.

STEP 6 – SPECIFY LIMITS ON UNCERTAINTY

The purpose of Step 6 is to specify the tolerance limits for decision errors, which are used by the decision makers to establish performance goals for the data collection design. The objective of the data collection design is to obtain data that reliably estimate the true nature of environmental conditions at Site 11. This process is presented in Section 4 of the Work Plan and the following presents specific information on Site 11.

Identify the Null Hypothesis and Specify the Decision Errors

The null hypothesis for this site specifies that the concentrations of one or more of the COPCs exceed PRGs or risk-based action levels and represent an unacceptable risk at the site.

The alternative hypothesis for this site specifies that the concentrations of one or more of COPCs do not exceed PRGs or risk-based actions levels and represent an acceptable risk at the site.

The false-positive and false-negative decision errors are discussed in Section 4 of the Work Plan.

Decision Error Limits

For the Phase II RI/FS, the allowable probability of making a false-positive decision has been designated as 0.05 (confidence of 95 percent) and an allowable probability of making a false-negative decision error has been designated as 0.20 (power of 80 percent).

Calculating the Number of Samples Necessary to Determine Risk

The number of sample locations necessary to determine the risk at a unit or a site were estimated using the process presented in Section 4 of the Work Plan. The number of additional sample locations needed to assess risk during the Phase II RI/FS is the difference between the total number of sample locations and the number of locations sampled during the Phase I RI (Table K-1).

Sampling Designs for the Operable Unit-3 Sites

Two types of sampling designs will be used to determine the soil conditions at Site 11. These sampling designs are:

- areal systematic random sampling based on a grid, and
- judgmental sampling.

A description of these Phase II RI/FS sampling designs is presented in Section 4 of the Work Plan. The first sampling design utilizes random positioning to produce an unbiased configuration of sample locations. The advantage of a random, unbiased sampling design is that the tolerance limits for false positive and false negative decision errors can be applied to the sample data and the risk decisions can be assigned a level of confidence.

The second sampling design used is judgmental sampling. The purpose of judgmental sampling is to provide answers to more specific questions or issues where considerable of information on the parameters of a population already exist. Confidence and power limits associated with statistically based sampling designs do not apply to judgmentally located samples. Decision errors must still be considered for judgmental samples; however, they will not be evaluated statistically. The decision errors associated with judgmental sampling are based on sample design errors and measurement errors. Assuming the best possible professional judgment was used to position the judgmental sample locations using existing data for the site, the most important decision errors will be associated with field and laboratory techniques involved with collection of the data. This makes careful application of field and laboratory techniques even more critical, due to the fact that corroborative data from multiple samples will not statistically evaluated.

STEP 7 – OPTIMIZE THE DESIGN

Historic site activities, previous site investigation results, and regulatory comments were used to formulate the Phase II RI/FS sampling approach. Shallow and deeper subsurface soils will be investigated at this site using a tiered sampling approach. This sampling approach consists of three tiers:

- The main focus of the Tier 1 sampling plan will be to determine whether the unit is a risk. The Tier 1 sampling approach will consist of collecting shallow soil samples (less than 10 feet bgs) from a specific number of sampling locations

Table K-1
Summary of Phase II RI/FS OU-3 Soil Sampling Strategies

Description	Unit Area	Estimated Risk[a]	Number of Locations/ Samples[b]	Number of Phase I Locations/ Samples	Number of Phase II Locations/ Samples[c]	Tier	Type of Sampling Strategy
Site 11 – Transformer Storage Area	Unit 3–27,800 ft^2	UNK	12(36)	0	6(18)	1	Aerial Systematic Random

Notes:

[a] These estimated cumulative cancer risk values were developed using Phase I RI data, and COPC-specific risk-based concentrations were developed following completion of Phase I RI activities. Numbers in parentheses are the estimated hazard index values.

[b] Number of samples based on comparison of estimated cancer risk to Table 4-7 in Phase II RI/FS Work Plan, which correlates four cancer-risk categories to the number of samples needed to determine that risk using the project-specific power and confidence limits. For this column, the first number represents sample locations, and the second number (in parentheses) is the number of samples based on an average of three depth intervals per sample location.

[c] These numbers represent the difference between the number of samples required to determine risk and the number of samples collected as part of the Phase I RI, with the following provisions:
Where Phase II RI/FS sample locations were recommended to determine risk, the area covered by this number of locations was based upon the U.S. EPA risk determination standard of a 40- x 40-meter block per sample location. This corresponds to an area of about 206,700 $feet^2$ for 12 sample locations. If the unit area is greater than this size limit, the maximum specified number of samples, less the Phase I RI number of samples, will be collected during the Phase II RI/FS. If the unit area is less than this size limit, the number of sample locations represents a ratio of the unit area versus the 12-sample area (206,700 $feet^2$) times 12 (e.g., Site 19, Unit 3: [Unit 3 area/206,700 $feet^2$]) x 2 locations = 9 locations needed - 3 Phase I locations = 6 new Phase II RI/FS locations required. Use of this ratio rule should maintain the necessary power and confidence limits at units where fewer samples are collected. At units where the ratio rule is applied, the total number of samples (Phase I and Phase II combined) will never be less than six despite the ratio calculation, to be sure that the minimum number of sample locations necessary for a risk assessment is collected. The number of Phase II RI/FS shallow soil boring locations has been based on three samples per location. However, at Site 8 (Unit 3) and Site 12 (Units 1, 2, and 4), four samples per location will be collected.

within the unit. The number of sampling locations has been proposed, such that when the Phase I and II RI/FS data are evaluated together, an assessment of risk can be completed for the unit.

- The Tier 2 sampling approach will also focus on shallow soil; however, the primary objective will be to refine the extent of shallow soil that has been impacted by site activities, by focusing on subareas of the unit where COPCs exceeded PRGs as identified by the Tier 1 sampling and/or Phase I RI/FS results.
- The Tier 3 sampling approach has been designed to estimate the horizontal and vertical extent of impacted subsurface soil (greater than 10 feet bgs). This sampling strategy will only be implemented if Phase I RI/FS soil sample analytical data or Phase II RI/FS Tier 1/Tier 2 soil sample analytical data suggest impacted soil exists at depths greater than 10 feet bgs. Groundwater will be investigated if Phase I or Phase II soil data indicate potential impacts to groundwater are possible.

The tiered sampling approach is detailed in the following sections and in the FSP, Attachment K (BNI 1995). For a list of all soil sampling and analysis at Site 11, see Table K-2.

Tier 1

The Tier 1 of sampling will be collection of shallow samples from each unit within the site as described below. For a list of all soil samples and analysis for Site 11, see Table K-2.

TIER 1 SOIL SAMPLING

Tier 1 sample locations within the unit will be positioned using areal systematic random sampling (grid) or judgmental sampling designs to provide sufficient data for the risk assessment and to characterize additional areas not sampled as part of the Phase I RI (Figure K-2).

Unit 1: Concrete Pad

Unit 1 is presently being addressed as a Early Action through the Non-Time-Critical Removal Action Process. An EE/CA has been prepared for this unit.

Unit 2: Drainage Ditch

Unit 2 has been approved for Early Action and is being addressed through the Non-Time-Critical Removal Action process. An EE/CA has been prepared for this unit.

Unit 3: Storage Yard

The objectives of this investigation are to collect sufficient data to support risk assessment and estimate the extent of PCB in soil.

Table K-2
Soil Sampling and Analysis

Tier	Unit/Name	PHASE II RI/FS SAMPLE NUMBERS			OFF-SITE LABORATORY[b]		
		No. of Locations	Samples/ Location	Total Samples	PCB and Pesticides	Herbicides	Others
Tier 1	Unit 3 -Storage Area	6 soil, 1 wipe	3 soil, 1 wipe	19	X		
Tier 1 Subtotals				19	19		
Tier 2	Optional: Scope of Tier 2 would be to further define extent of shallow soil contamination; based on Tier 1 data and Phase I RI findings, with approval of BCT						
Tier 3	Optional: Scope of Tier 3 would be to characterize horizontal and vertical extent of contamination below 10 feet depth; based on Tier 1 and 2 data, combined with the Phase I RI findings, with approval of BCT						

Notes:
[a] at a minimum, 10 percent of detects and 5 percent of nondetects go to the off-site laboratory for confirmation analyses
[b] these constituents cannot be determined in the field; all samples to be analyzed for these constituents will be sent to the off-site laboratory
[c] immunoassay analyses
[d] mobile laboratory analyses

The area of Unit 3 was not investigated during the Phase I RI. In the Phase II RI, Tier 1 soil samples will be collected at 0, 2, and 4 feet bgs from six sample locations based on an areal systematic random sampling design using a grid spacing of 65 by 75 feet (Figure K-3). All soil samples will be submitted to the fixed-base laboratory for chemical analyses. This fixed-base analysis is pesticides/PCB (U.S. EPA Method 8080) under Naval Facilities Engineering Service Center (NFESC; formerly known as (NEESA) Level D protocols. Attachment K in the FSP provides the sampling procedures for the Phase II RI/FS at Site 11, Unit 3 (BNI 1995).

In addition to the above sampling in Unit 3, one sample will also be collected from an underground storage tank (UST) that is present in the storage yard. If the UST contains fluid, then the fluid will be sampled and analyzed for PCB. If the UST does not contain fluid, one wipe sample will be collected from the bottom of the UST and analyzed for PCB. If PCB are present in the fluid or wipe sample, then two borings adjacent to the UST will be drilled to a depth below the bottom of the UST to determine if soils below the UST have been impacted. If the UST does not contain PCB, investigation will be deferred to the Base UST program.

Tier 2

The primary objective of the Tier 2 sampling program is to refine the extent of impacted soil identified within each unit by Phase I and/or II RI/FS sampling results. The Tier 2 sampling program will focus exclusively on shallow soil (0 to 10 feet depth) conditions and will further investigate subareas within the unit boundary that exceed PRGs.

The Tier 2 sampling plan will be developed after an evaluation of Phase I RI/FS and/or Phase II RI Tier 1 analytical results. If a Tier 2 sampling program meets the DQO for this unit, the decision to proceed will be based upon the criteria described in DQO Steps 2, 3, and 5. The proposed Tier 2 sampling plan, with recommendations, will be reviewed by the Base Realignment and Closure (BRAC) Cleanup Team (BCT). The BCT will decide whether the proposed Tier 2 sampling program will be implemented by the Navy.

TIER 2 SOIL SAMPLING

As noted, the objective of a Tier 2 sampling program is to refine the extent of impacted shallow soil within the unit being investigated. The rationale for accomplishing this objective depends primarily on the size and layout of the unit. Where the unit is a linear feature such as a drainage ditch, the Tier 2 program will focus sampling along the trend of the ditch bracketing the Tier 1 sampling locations (or Phase I RI/FS sample locations) where analyte concentrations exceeding PRGs are reported.

For units of rectangular, roughly circular, or irregular dimensions, a systematic random sampling based on a grid, stratified random sampling, or judgmental sampling approach will be used to define the extent of the Tier 1 sample location(s) where analyte concentrations exceeded PRGs. The limits of the area covered by these sampling approaches will be contingent upon the distribution of adjacent Tier 1 sample locations in which the COPCs were not detected.

The number of Tier 2 sampling locations (i.e., grid spacing) will be selected to achieve the following objectives:

- provide the areal coverage necessary to define the extent of shallow impacted soil, and
- minimize the cost associated with field and fixed-base laboratory sample testing.

The spacing between sampling locations for Tier 2 will be contingent upon the estimated size of the area to be investigated, and the spacing between Phase I or II RI/FS sample locations. Tier 2 soil sample depth intervals and chemical analyses will conform to those specified for Tier 1 soil sampling.

Tier 3

The Tier 3 sampling program would only be implemented at a unit where Phase I RI data or the initial evaluation of the Phase II RI Tier 1 and/or Tier 2 sampling program results suggest that soil contamination may extend to depths greater than 10 feet bgs.

The objectives of the Tier 3 sampling program are to estimate the horizontal and vertical extent of impacted subsurface soil (greater than 10 feet bgs) and assess whether groundwater beneath the site has been impacted by historic site activities. If impacted subsurface soil is limited to the vadose zone above the water table or vadose zone modeling does not suggest a potential for COPCs to impact groundwater, then groundwater quality will not be investigated.

The Tier 3 sampling plan will be developed after an evaluation of Phase I RI/FS and Phase II RI Tier 1 and/or 2 analytical results. If a Tier 3 sampling program meets the DQO for this unit, then the decision to proceed will be based upon the criteria described in DQO Steps 2, 3, and 5. The proposed Tier 3 sampling plan, with recommendations, will be reviewed by the BCT. The BCT will decide whether the proposed Tier 3 sampling program will be implemented.

Optimization of Sampling Plan

As soil analytical data become available from sampling in each unit, investigative plans for the site will be optimized. The proposed tiered sampling approach is an iterative process that will permit data from one tier to be evaluated prior to the implementation of the next tier of sampling. The iterative process involves review of data, recommendations for further actions, and approval of the BCT. In this way, the investigation can be optimized by performing the least amount of sampling necessary to assist the decision making process about future actions at the unit (i.e., NFI, Early Action, and Long-Term Action).

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U.S. EPA. *See* United States Environmental Protection Agency.

WORK PLAN APPENDIX L

DATA QUALITY OBJECTIVES
OPERABLE UNIT 3 –
SITE 12 – SLUDGE DRYING BEDS

SUMMARY

STEP 1 – STATE THE PROBLEM

Site 12, the Sludge Drying Beds, consists of two former locations of wastewater treatment plants, their associated sludge drying beds, and a drainage ditch adjacent to the sludge drying beds. The operations at these facilities have contaminated shallow soil and subsurface soil. Available information suggests that the contaminated soil may be limited to the shallow soil interval at depths of less than 0 feet below ground surface. The human health and ecological risks associated with the contaminated soil will be estimated so that a No Further Investigation, removal action, or the appropriate remedial alternative can be recommended.

STEP 2 – IDENTIFY THE DECISION

The Phase II Remedial Investigation/Feasibility Study decisions to be considered at Site 12 are as follows: Do chemicals of potential concern in the shallow soil at Site 12 present an unacceptable risk to human health and the environment? Are the chemicals of potential concern present in the subsurface soil (greater than 10 feet below ground surface), and if so, do they present an unacceptable risk to groundwater? The possible decision outcomes are recommendations for No Further Investigation, Early Action, or Long-Term Action.

STEP 3 – IDENTIFY THE INPUTS AFFECTING THE DECISION

Inputs necessary to make these decisions include a list of chemicals of potential concern; the extent of impacted media; the background (ambient) concentrations of metals, herbicides, and pesticides; and the action levels for protection of human health and the environment.

STEP 4 – DEFINE THE BOUNDARIES OF THE STUDY

The study is limited to the geographic area of Site 12, which comprises four subareas: 1) the West Sludge Drying Beds (approximately 63,800 square feet); 2) the East Sludge Drying Beds (approximately 34,300 square feet); 3) the Drainage Ditch (approximately 9,700 square feet), and 4) the sites of the Former Wastewater Treatment Plant and the Industrial Waste Treatment Plant (approximately 108,800 square feet total).

STEP 5 – DEVELOP A DECISION RULE

Action levels developed for decision-making purposes are a cumulative excess cancer risk of 10^{-6} in humans and a hazard index of 1.0 for chronic systemic toxicity in humans. Based on these risk levels, decision rules have been formulated to protect human health and the environment in residential, recreational, and industrial land use scenarios.

STEP 6 – SPECIFY LIMITS ON UNCERTAINTY

The number of samples necessary to estimate different levels of risk were calculated using the confidence level of 95 percent and power level of 80 percent limits specified for this project. The preliminary cancer and noncancer risk values were compared to the risk

levels, and the appropriate number of samples necessary to estimate risk were selected for each unit.

STEP 7 – OPTIMIZE THE DESIGN

Shallow soil samples will be collected and analyzed at 0, 2, 5, and 10 feet below ground surface in two locations in the West Sludge Drying Beds; four locations in the East Sludge Drying Beds; and eight locations within the area encompassing the Former Wastewater Treatment Plant and the Industrial Waste Treatment Plant. The drainage ditch has been designated as an early removal action site.

ACRONYMS/ABBREVIATIONS

AOC	area of concern
ARAR	applicable or relevant and appropriate requirement
BCT	BRAC Cleanup Team
bgs	below ground surface
BRAC	Base Realignment and Closure
COPC	chemical of potential concern
CRDL	contract-required detection limit
DDD	dichlorodiphenyldichloroethane
DDE	dichlorodiphenyldichloroethene
DDT	dichlorodiphenyltrichloroethane
DQO	data quality objective
EE/CA	Engineering Evaluation/Cost Analysis
FS	Feasibility Study
FSP	Field Sampling Plan
IDL	instrument detection limit
IWTP	Industrial Waste Treatment Plant
LUFT	(California) Leaking Underground Fuel Tank (Field Manual)
MCAS	Marine Corps Air Station
MCL	maximum contaminant level
MCPP	2-(2-methyl-4-chlorophenoxy)-propionic acid
MDL	method detection limit
µg/kg	micrograms per kilogram
µg/L	micrograms per liter
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
NEESA	Naval Energy and Environmental Support Activity
NFESC	Naval Facilities Engineering Service Center
NFI	No Further Investigation
PAH	polynuclear aromatic hydrocarbons
PCB	polychlorinated biphenyls
PRG	(U.S. EPA Region IX) Preliminary Remediation Goals

ACRONYMS/ABBREVIATIONS (continued)

QA/QC	quality assurance/quality control
RCRA	Resource Conservation and Recovery Act
RFA	RCRA Facilities Assessment
RI	Remedial Investigation
RI/FS	Remedial Investigation/Feasibility Study
SVOC	semivolatile organic compound
SWMU	solid waste management unit
TAL	target analyte list
TDS	total dissolved solids
TFH	total fuel hydrocarbons
TPH	total petroleum hydrocarbons
TRPH	total recoverable petroleum hydrocarbons
U.S. EPA	United States Environmental Protection Agency
VOC	volatile organic compound
WWTP	Wastewater Treatment Plant

Appendix L
SITE 12 - SLUDGE DRYING BEDS

The United States Environmental Protection Agency (U.S. EPA) developed the data quality objectives (DQO) process as a tool for project managers to determine the type, quantity, and quality of data needed to make decisions. Data produced by sampling and monitoring activities are used extensively in problem definition, rule-making, and enforcement decisions. These activities are supported through implementation of the mandatory U.S. EPA Quality System, which requires all organizations to develop and operate management processes and structures for assuring that the data collected are of the needed and expected quality for their desired use (U.S. EPA 1993).

The U.S. EPA DQO process consists of the following seven steps.

1. **State the problem:** Describe the problem at the site as it is currently understood. The problem statement includes a site conceptual model and an organization and review of all relevant data.
2. **Identify the decision:** Determine an if-then statement that will define what the investigation will seek to determine and what actions will be taken based on the possible outcomes of the investigation.
3. **Identify inputs into the decision:** Specify the analytes or parameters to be measured and used.
4. **Define the study boundary:** Delineate the study boundary from information obtained from Step 1.
5. **Develop a decision rule:** Restate the decision detailing the if-then statement in specific terms.
6. **Specify acceptable limits on decision errors:** Specify how the data will be treated statistically and what the acceptable limits of uncertainty are.
7. **Optimize the design:** Design the field investigation, giving adequate consideration to the results of Steps 5 and 6. This step is described in more detail in the Field Sampling Plan (FSP).

The following sections describe the DQO process for Site 12 – Sludge Drying Beds.

STEP 1 – STATE THE PROBLEM

Site 12 consist of two former locations of wastewater treatment plants, their associated sludge drying beds, and a drainage ditch adjacent to the sludge drying beds. The operations at these facilities have impacted shallow soil and subsurface soil.

Site Description

Site 12, the Sludge Drying Beds, is located in the southwest corner of Marine Corps Air Station (MCAS) El Toro near Plant Road, South Marine Way, and Bee Canyon Wash (Figure L-1). Between 1943 and 1972, the Former Wastewater Treatment Plant (WWTP) operated at Site 12. During the Phase I Remedial Investigation (RI) Site 12 comprised three areas: 1) the West Sludge Drying Beds; 2) the East Sludge Drying Beds; and 3) the drainage ditch. Site boundaries for MCAS El Toro Phase I RI were determined by consensus between the Navy and the regulatory agencies prior to initiation of the Phase I RI. Areas of concern (AOCs) were generally grouped together into sites based on common historical activities, aerial photograph reviews, and their locations respective to one another.

The WWTP stopped operation in the early 1970s and was demolished a few years later. The sludge produced at this facility was dewatered in the two drying bed areas (east and west). After the plant closed, the sludge may have been abandoned in the drying beds and, eventually, plowed under the soil surface (Jacobs Engineering 1993a).

The Industrial Waste Treatment Plan (IWTP) was also present at Site 12 to the east of the WWTP (Figure L-2). The IWTP was identified on historical aerial photographs dating back to 1952. The IWTP treated waste liquids generated during metal plating operations primarily at Buildings 296 and 297. Industrial sewer lines are believed to have brought processed liquid to the IWTP. Effluent lines ran from the IWTP to the WWTP. Sludge lines also ran from the IWTP and WWTP to the East and West Sludge Drying Beds. The plant reportedly operated for only a brief period in 1945-1946, and the facilities had been dismantled by 1961. No evidence of either the WWTP or the IWTP is visible today. The location of the former WWTP is currently a grassy picnic area and park.

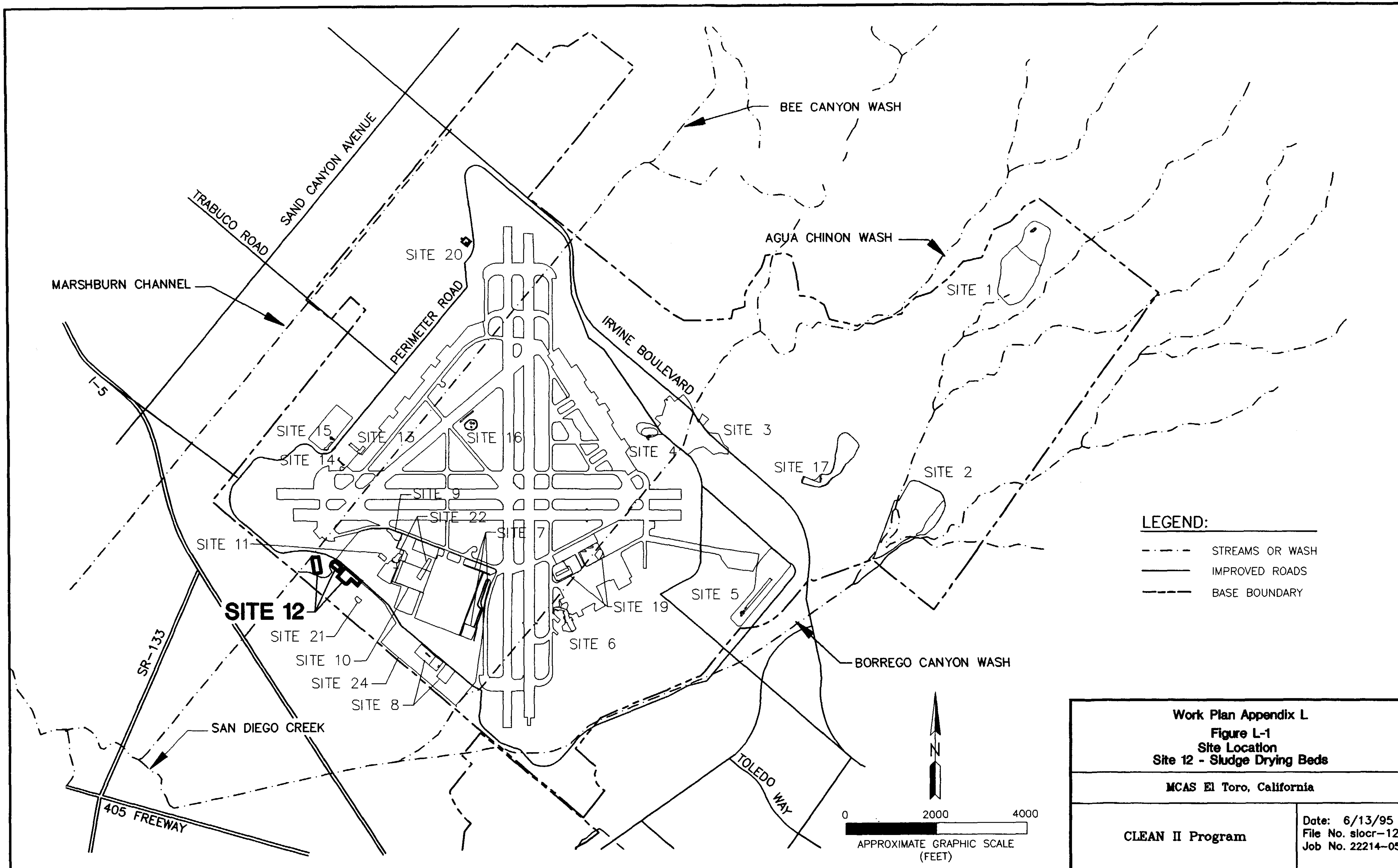
The sludge produced in the WWTP and IWTP may include silver, arsenic, selenium, cadmium, nickel, lead, mercury, copper, and zinc. These heavy metals are usually present in the waste stream associated with metal plating operations.

Previous Investigations

Investigations conducted at Site 12 include the Resource Conservation and Recovery Act (RCRA) Facilities Assessment (RFA), the Phase I RI, the aerial photographic surveys, and the employee interviews. The sections below provide a summary of each of these investigations.

RCRA FACILITIES ASSESSMENT

The site of the former WWTP was investigated during the RFA as a solid waste management unit (SWMU)/AOC 90, and the abandoned industrial sewer lines within the boundaries of Site 12 were investigated as SWMU/AOC 265. RFA activities at SWMU/AOC 265 included drilling and sampling of one 25-foot-deep boring on Site 12 along an abandoned metal plating sewer line. Activities at SWMU/AOC 90 included collecting and analyzing shallow soil samples from nine locations at the former WWTP for target analyte list (TAL) metals, volatile organic compounds (VOCs), semivolatile organic compounds (SVOC), pesticides and polychlorinated biphenyls (PCB), and petroleum hydrocarbons.



Work Plan Appendix L
Figure L-1
Site Location
Site 12 - Sludge Drying Beds

MCAS El Toro, California

CLEAN II Program

Date: 6/13/95
File No. slocr-12
Job No. 22214-059

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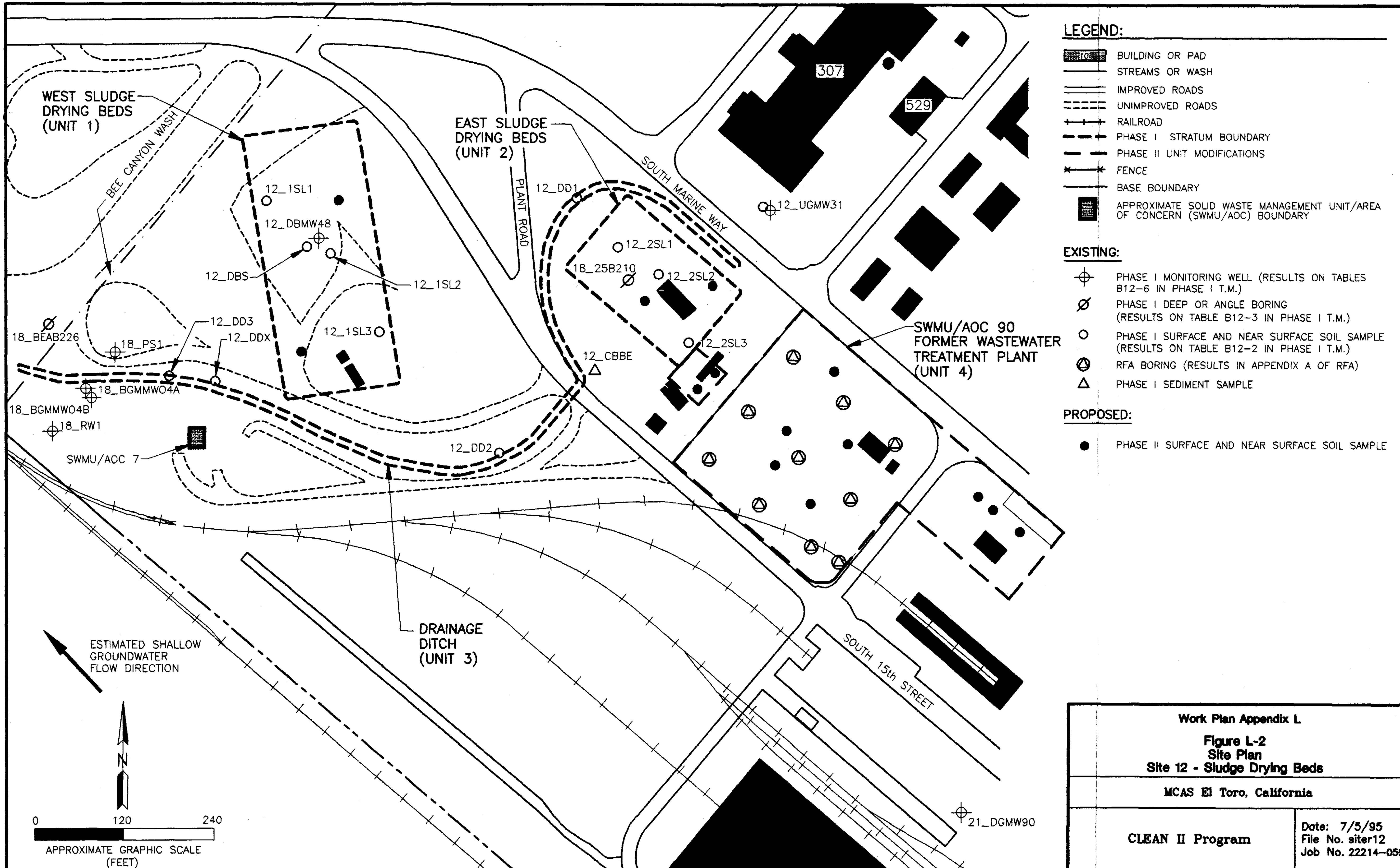

Work Plan Appendix L

Figure L-2
Site Plan
Site 12 - Sludge Drying Beds

MCAS El Toro, California

CLEAN II Program

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Job No. 22214-059

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A summary of the RFA analytical results (by chemical class and media) is presented below (sample identification of the highest concentrations are provided). All chemicals of potential concern (COPCs) that were detected in soil are listed with the exception of specific metals which are listed only if U.S. EPA Preliminary Remediation Goals (PRGs) or ecological screening criteria in shallow soil were exceeded (Jacobs Engineering 1993b). If a minimum concentration is recorded with a "less than" symbol, it denotes a concentration below the method detection limit (MDL). Sample locations are shown on Figure L-2. TAL metals that were analyzed during the RFA are beryllium, barium, arsenic, antimony, aluminum, cadmium, calcium, cobalt, copper, iron, lead, magnesium, manganese, mercury, nickel, potassium, selenium, silver, sodium, thallium, vanadium, and zinc.

Shallow Soil (SWMU/AOC 90)

- VOC: 2- butanone (< 11 to 3J micrograms per kilogram [µg/kg] [H7 at 2 feet]), acetone (< 11 to 28 µg/kg [H7 at 5 feet]), toluene (< 11 to 12 µg/kg [H5 at 2 feet]);
- SVOC: 2-methylnaphthalene (< 350 to 22J µg/kg [H3 at 2 feet]), 4-chloroaniline (< 350 to 130J µg/kg [H3 at 2 feet]), benzo(a)anthracene (< 350 to 140J µg/kg [H3 at 2 feet]), benzo(a)pyrene (< 350 to 190J µg/kg [H3 at 2 feet]), benzo(b)fluoranthene (< 350 to 210J µg/kg [H3 at 2 feet]), benzo(g,h,i)perylene (< 350 to 92J µg/kg [H3 at 2 feet]), benzo(k)fluoranthene (< 350 to 200J µg/kg [H3 at 2 feet]), benzyl butyl phthalate (< 350 to 310J µg/kg [H5 at 2 feet]), bis(2-ethylhexyl) phthalate (< 350 to 440 µg/kg [H3 at 4 feet]), chrysene (< 350 to 170J µg/kg [H3 at 2 feet]), diethyl phthalate (< 350 to 160J µg/kg [H3 at 2 feet]), dimethyl phthalate (< 350 to 94J µg/kg [H3 at 2 feet]), di-n-butyl phthalate (< 350 to 63J µg/kg [H4 at 2 feet]), fluoranthene (< 350 to 130J µg/kg [H3 at 2 feet]), indeno(1,2,3-cd)pyrene (< 350 to 210J µg/kg [H3 at 2 feet]), naphthalene (< 350 to 19J µg/kg [H3 at 2 feet]), phenanthrene (< 350 to 30J µg/kg [H3 at 2 feet]), pyrene (< 350 to 100J µg/kg [H3 at 2 feet]);
- pesticides and PCB: 4,4-dichlorodiphenyldichloroethane (DDD) (< 3.52 to 32J µg/kg [H3 at 2 feet]), 4,4-dichlorodiphenyldichloroethene (DDE) (< 3.52 to 70 µg/kg [H6 at 2 feet]), 4,4-dichlorodiphenyltrichloroethane (DDT) (< 3.52 to 67 µg/kg [H3 at 2 feet]), alpha-chlordane (< 1.9 to 13 µg/kg [H3 at 2 feet]), gamma chlordane (< 1.9 to 7.5J µg/kg [H3 at 2 feet]), Aroclor 1254 (< 3.52 to 13J µg/kg [H9 at 2 feet]), Aroclor 1260 (< 3.52 to 22J µg/kg [H5 at 2 feet]);
- metals: arsenic (1.8b to 103 milligrams per kilogram [mg/kg] [H7 at 5 feet]), copper (7.3 to 75.8 mg/kg [H3 at 2 feet]), mercury (< 0.05 to 7.4 mg/kg [H9 at 2 feet]), zinc (40.4 to 1,440 mg/kg) [H3 at 5 feet]; and 17 of the other 23 TAL metals; and
- fuel and petroleum hydrocarbons: total recoverable petroleum hydrocarbons (TRPH) (< 0.058 to 78.1 mg/kg [H1 at 2 feet]).

Subsurface Soil (SWMU/AOC 265)

- VOC: 2- butanone (< 11 to 4J µg/kg [B1 at 10 feet]);
- pesticides and PCB: methoxychlor (< 18.2 to 19 µg/kg [B1 at 15 feet]);
- metals: 17 of 23 TAL metals; and
- fuel and petroleum hydrocarbons: TRPH (< 0.058 to 0.067 mg/kg [B1 at 5 feet]).

J = Indicates an estimated value for qualitative use only (organic parameters)

(For additional information on SWMU/AOC 265, see Site 23, the Industrial Sewer Lines.)

Based on the analytical results of the shallow soil samples, benzo(a)pyrene, PCB (Aroclor 1260), and arsenic exceeded PRGs, and benzo(a)pyrene, DDE, arsenic, copper, mercury, and zinc exceed ecological criteria (Jacobs Engineering 1993b).

PHASE I REMEDIAL INVESTIGATION

For the Phase I RI, subareas within sites were designated as strata. Due to the fact that some new subareas have been added or subareas have been expanded or diminished for the Phase II RI/Feasibility Study (FS), subareas within sites will be referred to as units for the Phase II RI/FS. In this section, discussion is related to Phase I RI sampling and results and the term strata will be used. Following this section, the term unit will be used.

For the Phase I RI, Site 12 was divided into three strata (Figure L-2):

- Stratum 1 - West Sludge Drying Beds;
- Stratum 2 - East Sludge Drying Beds; and
- Stratum 3 - Drainage Ditch.

The following activities were conducted as part of Phase I RI (Jacobs Engineering 1993a):

- surface and shallow soil samples were collected at 13 locations (three each in Strata 1, 2, and 3; one at the deep boring; one at the 25-foot boring);
- one 25-foot deep boring was drilled and sampled at the East Sludge Drying Beds (Stratum 2);
- one deep boring was drilled, developed, and sampled as a monitoring well at the West Sludge Drying Beds (Stratum 1);
- two borings were drilled, completed as an upgradient monitoring well and a downgradient well, and sampled;
- soil samples were analyzed for VOC, SVOC, pesticides and PCB, TRPH, total fuel hydrocarbons (TFH), TAL metals, general chemistry; and
- groundwater samples were analyzed for VOC, SVOC, TRPH, TFH, TAL metals, pesticides and PCB, and general chemistry.

A summary of the ranges of analyte concentrations detected during the Phase I RI (sample identification of the highest concentration is provided), including recent groundwater monitoring data, is summarized below. All chemicals that were detected in soil are listed with the exception of specific metals that are only listed if they exceed PRGs or ecological screening criteria in shallow soil. All chemicals exceeding PRGs or maximum contaminant levels (MCLs) in groundwater are included in this list. A minimum concentration recorded with a "less than" symbol denotes a concentration below the U.S. EPA Contract Laboratory Program instrument detection limit (IDL). Sample locations are shown on Figure L-2. For a complete listing of all detected chemicals see Phase I RI Technical Memorandum, Appendix B-12, Tables B12-2 through B1-7 (Jacobs Engineering 1993a), and Groundwater Data Report (Jacobs Engineering 1994a):

Shallow Soil (less than 10 feet below ground surface)

- VOC: 2- butanone (< 10 to 79 µg/kg [12_1SL2 at 4 feet]), acetone (< 10 to 35 µg/kg [12_DD3 at 0 feet]), carbon disulfide (< 10 to 2J µg/kg [12_DD1 at 2 feet]) carbon tetrachloride (< 10 to 6J µg/kg [12_DD1 at 0 feet]), methylene chloride (< 10 to 35B µg/kg [12_CBBE at 0 feet]), toluene (< 10 to 9J µg/kg [12_DD2 at 0 feet]), and xylenes (< 10 to 2J µg/kg [12_DDX at 1 foot]);
- SVOC: benzo(a)pyrene (< 670 to 670 µg/kg [12_DBS at 0 feet]), benzo(a)anthracene (< 670 to 690 µg/kg [12_DBS at 0 feet]), benzo(b)fluoranthene (< 670 to 930 µg/kg [12_DD3 at 0 feet]), benzo(g,h,i)perylene (< 670 to 340J µg/kg [12_DBS at 0 feet]), benzo(k)fluoranthene (< 670 to 550J µg/kg [12_DD3 at 0 feet]), bis(2-ethylhexyl) phthalate (< 670 to 600J µg/kg [12_DD1 at 0 feet]), chrysene (< 670 to 1,000 µg/kg [12_DBS at 0 feet]), dibenzo(a,h)anthracene (< 670 to 130J µg/kg [12_DD3 at 0 feet]), fluoranthene (< 670 to 1,700 µg/kg [12_DD3 at 0 feet]), indeno(1,2,3-cd)pyrene (< 670 to 440J µg/kg [12_DBS at 0 feet]), phenanthrene (< 670 to 590J µg/kg [12_DD3 at 0 feet]), pyrene (< 670 to 1,100 µg/kg [12_DBS at 0 feet]);
- herbicides: 2,4-dichlorophenoxy acetic acid (< 10 to 140 µg/kg [12_DD1 at 0 feet]), dalapon (< 10 to 241 µg/kg [12_1SL2 at 4 feet]), 2-(2-methyl-4-chlorophenoxy)-propionic acid (MCPP) (< 10 to 153,000 µg/kg [12_DD2 at 2 feet]);
- pesticides and PCB: PCB (Aroclor 1254) (< 34.6 to 2,490J µg/kg [12_DD1 at 0 feet]), alpha chlordane (< 1.84 to 78.5JN µg/mg [12_DD1 at 0 feet]), DDD (< 3.68 to 1190 µg/kg [12_DD1 at 0 feet]), DDE (< 3.68 to 281J µg/kg [12_DD1 at 0 feet]), DDT (< 3.68 to 3,650J µg/kg [12_DD1 at 0 feet]), dieldrin (< 3.68 to 104J µg/kg [12_DD1 at 0 feet]), endosulfan sulfate (< 3.46 to 0.474 µg/mg [12_CBBE at 0 feet]), endrin aldehyde (< 3.46 to 85.6JN µg/mg [12_DD1 at 0 feet]), endrin ketone (< 3.34 to 133 µg/mg [12_DDX at 1 foot]), gamma chlordane (< 1.84 to 93.1JN µg/mg [12_DD1 at 0 feet]), methoxyclor (17.2 to 175 µg/mg [12_DDX at 1 foot]);

- metals: aluminum (2,460 to 28,200 mg/kg [12_DD2 at 4 feet]), barium (50.9 to 355 mg/kg [12_CBBE at 0 feet]), lead (0.02 to 531 mg/kg [12_DD1 at 0 feet]), mercury (< 0.03 to 1.3 mg/kg [12_CBBE at 0 feet]), vanadium (14.9 to 800 mg/kg [12_DDX at 1 foot]), zinc (33 to 418 mg/kg [12_DD1 at 0 feet]) and 16 of 23 TAL metals;
- fuel and petroleum hydrocarbons: TFH-diesel (< 12.5 to 1,970 mg/kg [12_DDX at 1 foot]) , TFH-gasoline (< 0.051 to 24.7 mg/kg [12_DDX at 1 foot]), TRPH (< 20 to 42,529 mg/kg [12_DDX at 1 foot]).

Subsurface Soil (greater than 10 feet below ground surface)

- VOC: 2- butanone (< 11 to 6J µg/kg [12_DBMW48 at 15 feet]), acetone (< 11 to 69 µg/kg [12_UGMW31 at 100 feet]);
- SVOC: di-n-oxylphthalate (< 720 to 330J µg/kg [12_25B210 at 25 feet]);
- pesticides and PCB: 4,4-DDE (< 3.97 to 24.4 µg/kg [12_25B210 at 5 feet]), 4,4-DDT (< 3.65 to 29.1 µg/kg [12_25B210 at 5 feet]);
- metals: 18 of 23 TAL metals;
- fuel and petroleum hydrocarbons: TFH-gasoline (0.054 to 0.133 mg/kg [12_DBMW48 at 20 feet]), TRPH (20 to 192 mg/kg [12_DBMW48 at 20 feet]).

Groundwater (12_UGMW31 upgradient)

- general chemistry: nitrate/nitrite-N (22.2 to 22.5J milligrams per liter [mg/L]), sulfate (246 to 263 mg/L), total dissolved solids (TDS) (1,100 to 1,160 mg/L);
- metals: 15 of 23 TAL metals;
- VOC: chloroform (0.4J to 0.5J micrograms per liter [µg/L]), trichloroethylene (7 µg/L*);
- herbicides: 2,4-DB (< 0.98 to 2.88J µg/L), 2,4,5-T (< 1.85 to 2.51 µg/L), dichloroprop (1.52 to 6.41 µg/L), MCPP (< 522 to 3,530 µg/L);

Groundwater (12_DBMW48 on-site)

- general chemistry: chloride (392 to 401 mg/L), nitrate/nitrite-N (22.9 to 23.8 mg/L), sulfate (497 to 549 mg/L), TDS (1,800 to 2,248 mg/L);
- metals: antimony (< 12.7 to 18B µg/L) and 14 other TAL metals; and
- VOC: carbon tetrachloride (0.5J to 0.6J µg/L), methyl chloride (1J to 2J µg/L), tetrachloroethylene (14 to 18 µg/L), trichloroethylene (0.7J to 0.8J µg/L).

* = indicates concentration repeated for two sampling events.

J = Indicates an estimated value for qualitative use only (organic parameters).

JN = Indicates compound is tentatively identified (gas chromatograph only).

B = Indicates reported value is less than the contract-required detection limit (CRDL), but greater than the or equal to the IDL (inorganic parameters).

The analyte concentrations detected in shallow soil were compared to the PRGs and ecological screening criteria.

- In Stratum 1, benzo(a)pyrene, benzo(a)anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene, indeno(1,2,3-cd)pyrene, dieldrin, and Aroclor 1254 exceeded PRGs; and benzo(a)pyrene, DDE, lead, mercury, and zinc exceed ecological screening criteria;
- In Stratum 2, Aroclor 1254 exceed PRGs; and DDE, DDT, lead, and mercury exceed ecological criteria; and
- In Stratum 3, benzo(a)pyrene, benzo(a)fluoranthene, benzo(k)fluoranthene, DDT, dieldrin, MCPP, Aroclor 1254, and lead exceed PRGs; DDD, DDE, DDT, aluminum, barium, lead, vanadium, and zinc exceeded ecological criteria.

Petroleum hydrocarbons detected in shallow soil were also compared to California Leaking Underground Fuel Tank (LUFT) Field Manual guidelines (LUFT 1989) to evaluate their potential to migrate to the groundwater. Based on LUFT guidelines, petroleum hydrocarbons in Stratum 3 may pose a threat to groundwater. COPCs detected in deep soil (below 10 feet below ground surface [bgs]) were not found to have the potential to contaminate the groundwater (Jacobs Engineering 1993a).

Groundwater samples were collected from the two groundwater monitoring wells constructed at Site 12. The COPCs concentrations were compared to applicable the PRGs and MCLs. The results are as follows:

- carbon tetrachloride, tetrachloroethene, and antimony, exceed PRGs in the on-site well;
- chloride, nitrate/nitrite-N, sulfate, and TDS exceed MCLs in the on-site well;
- trichloroethene, MCPP exceed PRGs in the upgradient well; and
- nitrate/nitrite-N, sulfate, and TDS exceed MCLs in the upgradient well.

U.S. EPA AERIAL PHOTOGRAPH SURVEY

The West Sludge Drying Beds were first observed on 1952 photographs; however, by 1965, only their outline was visible on photographs. Aerial photographs from 1952 to 1970 show two small impoundments between the East Sludge Drying Beds and the WWTP. One impoundment and two vertical tanks are visible in the 1952 photographs located across M Street, just south of South Marine Way. The impoundment and the tanks are no longer evident on the 1965 photographs (Jacobs Engineering 1993c).

SCIENCE APPLICATIONS INTERNATIONAL CORPORATION AERIAL PHOTOGRAPH SURVEY

The WWTP was first visible on the 1946 photograph. On the 1952 photograph, light-colored, mounded material was noted on the shoulders of Bee Canyon Wash (possibly related to dredging of the wash). The 1955 photograph shows two vertical tanks located east of the WWTP and across M Street. On the 1958 photograph, a possible liquid or a wet soil was identified in the northernmost portion of the West Beds. By 1961, the beds had been revegetated and only their outlines were visible. One impoundment and six small vertical tanks, also noted on the 1961 photograph, appear in the area where the U.S. EPA photographs had identified two small impoundments. Mounded material was identified at several different locations. In the southern portion of the former Western Sludge Drying Beds, mounded material was visible on the 1974 photograph. Additional mounded material was observed west of Bee Canyon Wash on the 1973 and 1984 photographs (SAIC 1993).

EMPLOYEE INTERVIEWS

On 26 May 1994, a meeting was held at MCAS El Toro to interview active and retired personnel from the Station Fuel Operations Division and Facility Management Department (currently the Installations Department) with knowledge of the Station operations and the procedures for the storage/disposal of hazardous materials and waste. Participating as interviewers during the meeting were agency personnel, Navy and Station personnel, and personnel from the contractors for the Navy and the U.S. EPA. During these interviews, the following information pertaining to Site 12 was obtained (Jacobs Engineering 1994b):

- Mr. J. Carson (retired after working for 25 years in the Facilities Management Department) indicated metal-plating activities were conducted in aircraft hangars (Buildings 295, 296, 297, and 324). It was common practice to dump cleaning fluids down the drains (industrial waste lines); and
- Mr. Carson also said that some transformers were stored at Site 12 from the late 1940s through 1991; when all transformers were removed from the Station by an outside contractor. This area is presently being investigated as part of the RFA Investigation as SWMU/AOC 7.

Geology

The geology of Site 12 consists of Quaternary alluvial and marine deposits (Jacobs Engineering 1993a). Holocene deposits consist of fine-grained overbank deposits and coarse-grained stream channel deposits. These soils are derived from the Santa Ana Mountains to the east and conformably overlie Pleistocene interbedded fine-grained lagoonal and near-shore marine deposits. Pleistocene deposits could not be differentiated from Holocene deposits in Phase I RI soil borings. Pleistocene deposits unconformably overlie semiconsolidated marine sandstones, siltstones, and conglomerates of late Miocene to late Pliocene, which are considered to be bedrock in the area.

Site 12 is located in the alluvial basin area of MCAS EL Toro. Boring logs from the Phase I RI indicate subsurface lithology at Site 12 consists of sandy soil with varying amounts of silt, clay, and gravel.

Hydrogeology

MCAS El Toro lies within the Irvine Groundwater Basin, a subbasin of the Los Angeles groundwater basin. Regional aquifers in the Irvine Subbasin tend to be composed of discontinuous lenses of clayey and silty sands and fine grained gravels contained within a complex assemblage of sandy clays and sandy silts. Three general aquifer systems have been identified near the Station: a shallow and perched system, a principal aquifer zone, and a lower hydrogeologic system existing in bedrock (Jacobs Engineering 1993a).

The Phase I RI results indicate that the shallow, perched zone is not present at Site 19. The principal aquifer is present beneath Site 12 at a depth between 95 and 105 feet bgs. The regional groundwater flow direction is to the northwest. The local hydraulic gradient has been influenced strongly by the pumping of irrigation wells located west of MCAS El Toro.

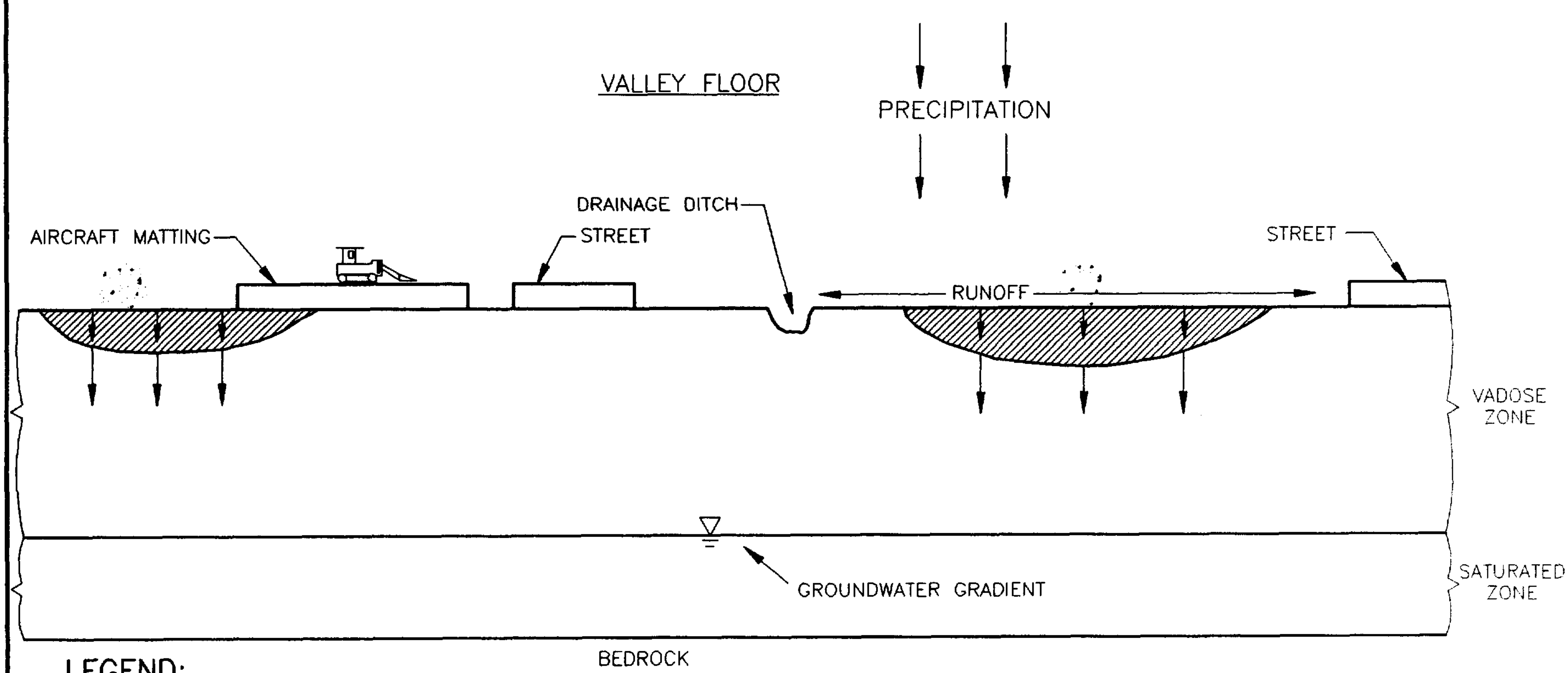
Conceptual Site Model

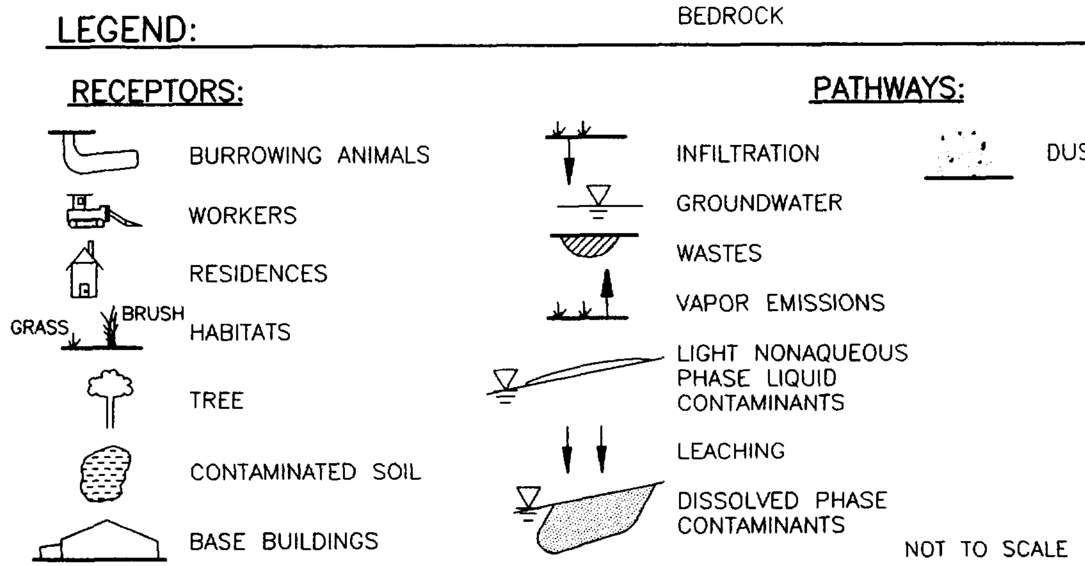
In the process of developing a conceptual site model, release mechanisms and potential sources of contamination were considered and evaluated to determine their applicability to the site. Also considered in the development of the conceptual site model were potential receptors and contaminant pathways to potential receptors. Figure L-3 illustrates the conceptual site model developed for the site. Figure L-4 depicts the potential exposure routes and pathways for human and ecological receptors.

The primary release mechanism is the surficial release of contaminants to shallow soil from wastewater, sludges, various organic wastes, and PCB-contaminated oil that were brought into contact with soil at this site. Eventually under gravity, contaminants present in shallow soil may move downward with soil moisture (in dissolved phase) or in a liquid phase. The depth of groundwater is reported to be about 100 feet bgs.

The secondary source of contaminants is the surrounding soil impacted by disposal activities. Several secondary release mechanisms are releases of the dust brought into suspension in the air with potential contaminants, volatilization of organic compounds, or infiltration of contaminants into deeper subsurface soils.

The potential pathways are air and groundwater. Airborne contaminants are transported through fugitive dust and volatilization. The transport through air is affected by wind speed and direction, type of contaminant, and weather conditions. Typical wind condition at MCAS E1 Toro is from west/southwest at less than 10 knots. Transportation of airborne contaminants through volatilization is expected to be largely unimportant at this site.





NOT TO SCALE

Work Plan Appendix L

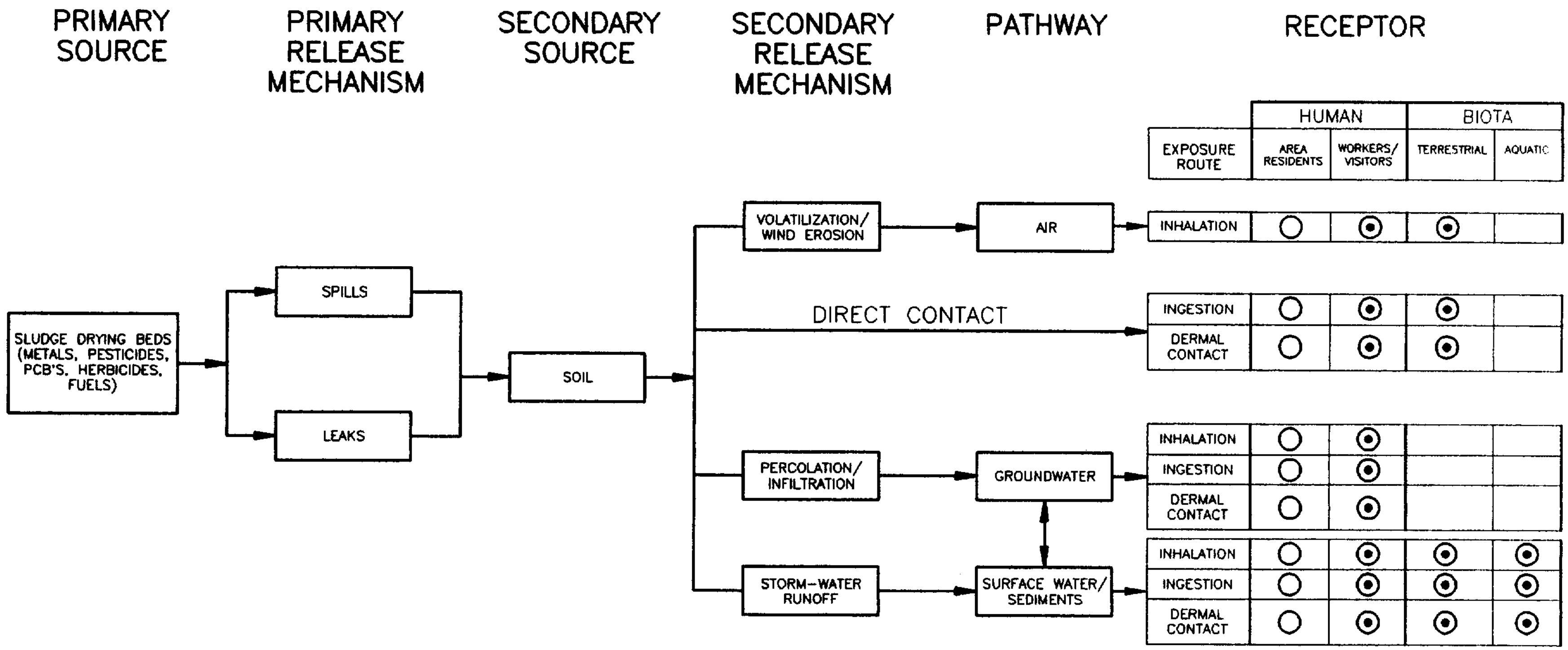
Figure L-3

Conceptual Site Model
Site 12 - Sludge Drying Beds

MCAS El Toro, California

CLEAN II Program

Date: 03/13/95
File No. model-12
Job No. 22214-059



LEGEND:

● CURRENT POTENTIAL RECEPTOR

○ FUTURE POTENTIAL RECEPTOR

Work Plan Appendix L

Figure L-4

Exposure Routes and Receptors
Site 12 - Sludge Drying Beds

MCAS El Toro, California

CLEAN II Program

Date: 6/28/95
File No. mod12
Job No. 22214-059

Current and/or potential receptors of chemicals at this site are workers and visitors involved in disposal activities. Direct contact with surface and subsurface soils is currently possible via dermal or ingestion exposures to workers. Infiltration of contaminated water through the vadose zone into groundwater is possible because subsurface soil is mainly sands, with some silts and clays. However, current exposure of workers is unlikely via ingestion of groundwater at this site.

Terrestrial wildlife could be exposed to chemicals in on-site surface soil, and dust and vapors through ingestion, dermal absorption or inhalation. Terrestrial plants could also be exposed through root absorption of chemicals in surface soil or deposition of dusts. No special-status species were observed at this site, and the immediate area provides marginal habitat for wildlife species.

Removal Action

In meetings with the Base Realignment and Closure (BRAC) Cleanup Team (BCT) during June 1995, Unit 3 of Site 12 was designated as a removal action site. This designation occurred because the nature and extent of contaminants is known and criteria of a Non-Time-Critical Removal Action were satisfied (Section 5 of the Work Plan). An Engineering Evaluation/Cost Analysis (EE/CA), Action Memorandum and community relations are being prepared for this removal action.

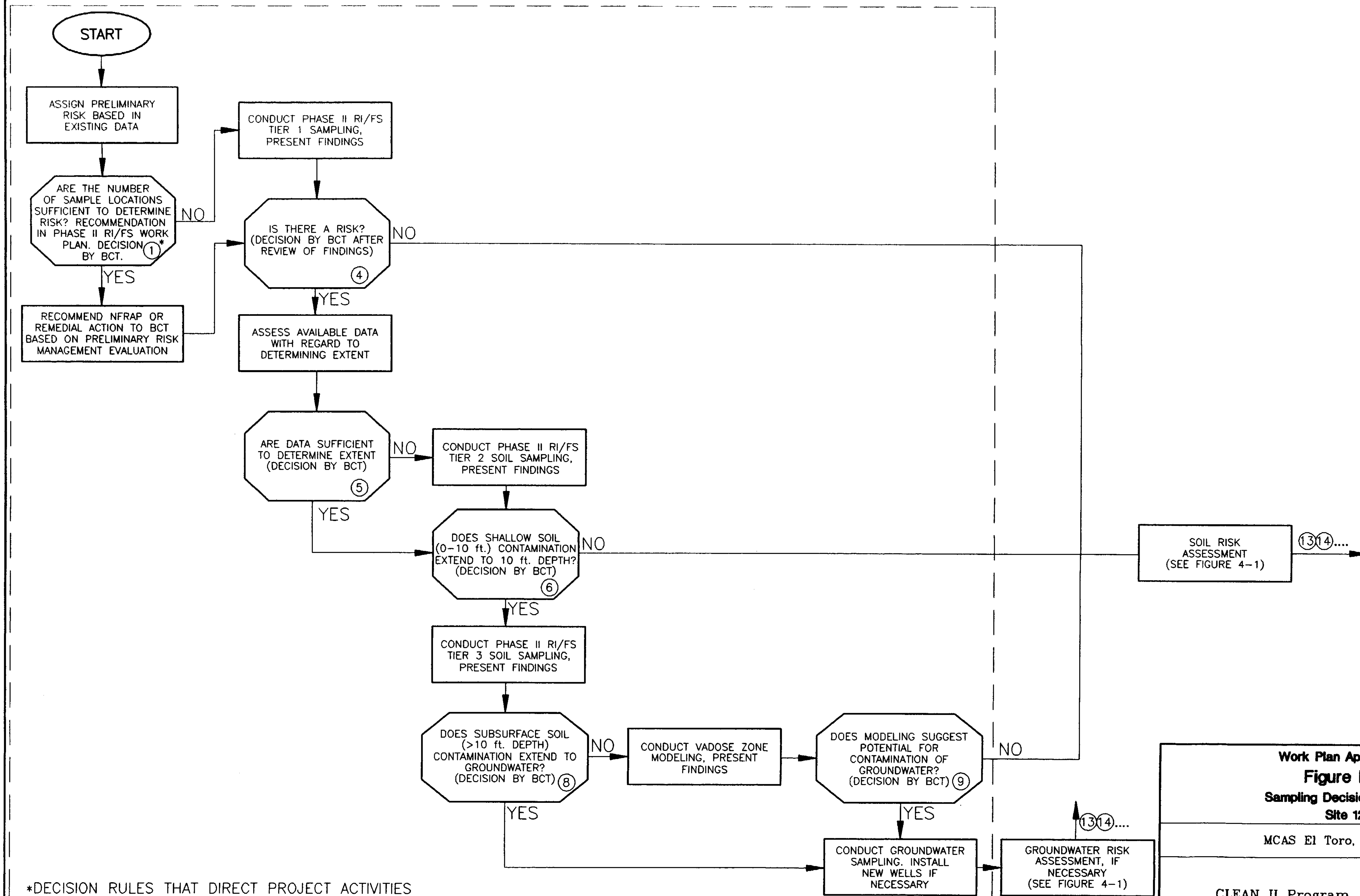
Statement of Phase II RI/FS Problem

The Sludge Drying Beds (Site 12) are located in the southwest corner of MCAS El Toro near Plant Road, South Marine Way, and Bee Canyon Wash. The problems associated with this site are as follows:

- shallow soil is impacted with VOC, SVOC, pesticides, PCB, and petroleum hydrocarbons;
- pesticides, PCB, SVOC, and several metals in shallow soil exceed PRGs and ecological criteria;
- based on LUFT Field Manual guidelines (LUFT 1989), petroleum hydrocarbons detected in shallow soil may pose a threat to groundwater; and
- Additional data are necessary to calculate a cumulative excess cancer risk and hazard index for the site.

STEP 2 – IDENTIFY THE DECISION

This step describes the decisions that will be considered during the DQO process for Site 12. For each decision, the alternative outcomes are stated. The Sampling Decision Process is illustrated on Figure L-5. For Site 12, the following decisions will be considered:



Work Plan Appendix L

Figure L-5

Sampling Decision Process

Site 12

MCAS El Toro, California

CLEAN II Program

Date: 3/11/95
File No. Logicr12
Job No. 22214-059

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1. Do COPCs in shallow soil (less than 10 feet bgs) in the unit exceed established background concentrations and PRGs, and/or do they present an unacceptable risk to human health or the environment?

   If yes, proceed to the next decision.

   If uncertain, collect additional soil samples to determine.

   If no, recommend the unit for No Further Investigation (NFI).

2. Has the extent of impacted soil been defined in the shallow soil?

   If yes, evaluate a response action.

   If no, conduct soil sampling to define extent.

3. Does the extent of impacted shallow soil extend into the subsurface (greater than 10 feet bgs)?

   If yes, conduct soil sampling to define vertical extent of impacted soil, and if necessary, evaluate potential impacts to groundwater beneath the site.

   If no, evaluate a response action.

4. Do the media being evaluated for a response action qualify for Early Action?

   If yes, recommend unit for an EE/CA.

   If no, recommend unit for a remedial response as part of the RI/FS process.

STEP 3 – IDENTIFY THE INPUT AFFECTING THE DECISION

Step 2 defined the decisions addressing possible actions at the site. Step 3 will identify the inputs that are required to assess the actions as discussed below:

Inputs for No Further Investigation

Input information required to support a NFI recommendation will also be used to support decisions for Early Action and Long-Term Action. These inputs are as follows:

- list of COPCs;
- definition of the extent of impacted soil;
- background concentrations for metals, pesticides, and herbicides;
- determination of risk for the unit; and
- action levels for the protection of human health and the environment.

Inputs for Early Action

In addition to the inputs required for a NFI recommendation, input information required to support an Early Action recommendation will include the following:

- applicable or relevant and appropriate requirements (ARARs);
- identification of cleanup standards;
- identification of cleanup technology applicability/limitations that are not extensive operation and maintenance activities; and
- site/unit cleanup in less than 5 years.

Inputs for Long-Term Action

In addition to the inputs required for a NFI recommendation, input information required to support a Long-Term Action recommendation may include the following:

- ARARs;
- identification of cleanup standards;
- identification of cleanup technology applicability/limitations;
- pilot testing of remedial alternatives; and
- site/unit cleanup in more than 5 years.

Descriptions of Inputs

The following subsections discuss the inputs required to assess possible response actions.

CHEMICALS OF POTENTIAL CONCERN

The Phase II RI/FS COPCs for Site 12 include all chemicals detected in the Phase I RI for each medium and stratum. COPCs for Site 12 are listed (by chemical class and media) below.

Shallow Soil (less than 10 feet below ground surface)

- metals: aluminum, antimony, arsenic, barium, beryllium, cadmium, chromium*, cobalt, copper, lead, manganese, mercury, nickel, selenium, silver, thallium, vanadium, zinc;
- VOC: 2-butanone, acetone, carbon disulfide, carbon tetrachloride, methylene chloride, toluene, and xylenes;
- SVOC: benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, bis(2-ethylhexyl) phthalate, chrysene, dibenzo(a,h)anthracene, fluoranthene, indeno(1,2,3-cd)pyrene, phenanthrene, pyrene;
- herbicides: dalapon, 2,4-D, MCPP;
- pesticides and PCB: alpha chlordane, gamma chlordane, 4,4'-DDD, 4,4'-DDE, 4,4'-DDT, dieldrin, endosulfan sulfate, endrin aldehyde, endrin ketone, methoxychlor, Aroclor 1254, Aroclor 1260; and
- fuel and petroleum hydrocarbons: TFH-gasoline, TFH-diesel, TRPH.

Subsurface Soil (greater than 10 feet below ground surface)

- metals: aluminum, antimony, arsenic, barium, beryllium, cadmium, chromium*, cobalt, copper, lead, manganese, mercury, nickel, selenium, silver, thallium, vanadium, zinc;
- VOC: 2-butanone, acetone, carbon disulfide, carbon tetrachloride, methylene chloride, toluene, and xylenes;
- SVOC: benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, bis(2-ethylhexyl) phthalate, chrysene, dibenzo(a,h)anthracene, di-n-oxylphthalate, fluoranthene, indeno(1,2,3-cd)pyrene, phenanthrene, pyrene;
- herbicides: dalapon, 2,4-dichlorophenoxy acetic acid, MCPP;
- pesticides and PCB: alpha chlordane, gamma chlordane, 4,4'-DDD, 4,4'-DDE, 4,4'-DDT, dieldrin, endosulfan sulfate, endrin aldehyde, endrin ketone, methoxychlor; and
- fuel and petroleum hydrocarbons: TFH-gasoline, TFH-diesel, TRPH.

* = Soil samples will be field screened for total chromium, if the sample result indicates a concentration of chromium of 50 parts per million or greater, then the soil sample will be further analyzed for hexavalent chromium by a fixed-base laboratory under Naval Facilities Engineering Service Center (NFESC; formerly known as NEESA) Level D protocol.

Groundwater – Upgradient

- metals: aluminum, antimony, barium, copper, manganese, mercury, nickel, selenium, vanadium, zinc;
- VOC: chloroform, trichloroethylene; and
- herbicides: 2,4-DB, 2,4,5-trichlorophenoxyproprionic acid, dichloroprop, MCPP;

Groundwater – On-Site

- metals: aluminum, antimony, arsenic, barium, cadmium, manganese, mercury, nickel, selenium, vanadium; and
- VOC: carbon tetrachloride, methylene chloride, tetrachloroethylene, trichloroethylene.

THE NATURE AND EXTENT OF CONTAMINATION

Phase II RI/FS sample locations, depths, and chemical analyses have been designed to assess the risk associated with the site. Additional sampling will be conducted if it is necessary to further define the extent of impacted shallow soil, subsurface soil, or groundwater.

BACKGROUND CONCENTRATIONS

The background concentrations for metals, herbicides, and pesticides are presented in Section 4 of the Phase II RI/FS Work Plan.

DETERMINATION OF RISK

A determination of the human health risk associated with each site is based on a baseline or streamline risk assessment. Baseline risk assessments are performed on RI/FS sites. The objective of a baseline risk assessment is to estimate the risks associated with the no action alternative and thereby provide decision makers information useful in identifying the most appropriate remedial action alternative. The risk estimates produced also serve as a benchmark to which reductions in risk achieved by remedial actions may be compared. Streamlined risk assessments are performed on removal action sites to support the removal action.

In addition to the human health risk assessment conducted for a site, an ecological risk assessment may also be performed. The ecological risk assessment will evaluate current and potential risks to the environment posed by the chemical releases that have occurred at the sites.

IDENTIFICATION OF CLEANUP LEVELS

Cleanup levels will be based on ARARs, background concentrations, and risk levels that will be determined for the site.

CLEANUP TECHNOLOGY EFFECTIVENESS, IMPLEMENTABILITY, AND COSTS

Once cleanup levels have been established, the most appropriate and cost-effective approach will be identified to remediate the site, if necessary.

STEP 4 – DEFINE THE BOUNDARIES OF THE STUDY

This step defines the spatial and temporal boundaries of the problem and any practical constraints that may interfere with the study.

- Unit 1 - the West Sludge Drying Beds (approximately 63,800 feet^2) are located between Bee Canyon Wash and Plant Road south of South Marine Way. This unit has the same boundaries as Phase I RI Site 12 Stratum 1.
- Unit 2 - the East Sludge Drying Beds (approximately 34,300 feet^2) lie east of Plant Road and west of South Marine Way. This unit has the same boundaries as Phase I RI Site 12 Stratum 2, except for a small area outside the southeast corner of Unit 2 that was added for the Phase II RI/FS. California EPA requested this area be investigated because two small impoundments were located there previously.
- Unit 3 - the Drainage Ditch (approximately 9,700 feet^2) runs from east to west around much of the perimeter of the East Beds, south of the West Beds, and into

the Bee Canyon Wash. The ditch receives runoff from both the West and East Beds area. This unit has the same boundaries as Phase I RI Site 12 Stratum 3.

- Unit 4 - WWTP and IWTP (approximately 108,800 feet^2) are located southeast of the East Sludge Drying Beds. The unit consists of about six acres of flat grassy area. The WWTP area was investigated as SWMU/AOC 90 during the RFA; however, the IWTP was not investigated.

Specification of temporal boundaries for the field sampling activities is unnecessary. Shallow and deeper subsurface soil conditions are not considered to be significantly different from conditions during the Phase I RI sampling or throughout the period since spillage or unregulated waste disposal activities occurred on the site.

STEP 5 – DEVELOP A DECISION RULE

Decision rules are required to state explicitly the types of inputs and logical basis for choosing among alternative actions during the Phase II RI/FS. A list of all decision rules for the project are included in Section 4 of the Work Plan. The specific decision rules that will be followed to determine an action are presented here. These decision rules conform to the numbering sequence presented in Section 4 of the Work Plan.

2. If Phase I data are sufficient to assess a response action to reduce risk associated with site units that exceed media action levels or background concentrations, then the cleanup levels and appropriate response action (Early Action or Long-Term Action) will be determined.
3. If Phase I data are not sufficient to assess whether risks are present based on the minimum number of samples, then Tier 1 sampling of the Phase II RI/FS will be completed to supplement the Phase I analytical results so the minimum number of samples is satisfied to assess whether action levels or background concentrations are exceeded in site units.
4. If Phase I data and Tier I data for the Phase II RI/FS indicate that no solid wastes are exposed and respective action levels or background concentrations for the various media of a site unit are not exceeded, then NFI will be recommended.
5. If Phase I data or Tier 1 data of the Phase II RI/FS combined with Phase I data exceed PRGs, action levels, or background concentrations for the various media, then Tier 2 of the Phase II RI/FS sampling and analyses will be conducted to define horizontal and vertical extent, provided additional sampling costs are not more than a potential response action.
6. If PRGs, action levels, or background concentrations for shallow soil are exceeded, and if COPCs detected in the soil extend to 10 feet bgs, then soil below 10 feet bgs (subsurface soil) will be investigated to assess the horizontal and vertical extent of the COPCs.
7. If during the investigation of COPCs in subsurface soil, two consecutive soil sample analyses (at a minimum 5-foot-depth separation) demonstrate that COPCs are not

detected, then the vertical extent of soil contamination will be established and investigation of subsurface soil will be halted at that location. The horizontal extent will be established when COPCs are not detected in vertical samples taken at three locations around the sample that exceeds the action levels.

The lowest detection limit available will be used to define the base of a contaminant plume. COPC detection or quantitation limits that will be compared to establish the base of the contaminant plume include the following:

- CRDL,
- contract-required quantitation limit
- sample quantitation limit,
- estimated quantitation limit,
- practical quantitation limit,
- MDL, and
- IDL.

8. If during the investigation of COPCs in subsurface soil, it is determined by actual sampling that COPCs extend to the water table, groundwater beneath the site will be investigated for the presence of the COPCs.
9. If COPCs are identified in subsurface soil below 10 feet bgs, above background and action levels, but do not extend to the water table, then vadose zone computer modeling will be used to evaluate the potential for the COPCs to impact groundwater.
10. If it is determined that COPCs in subsurface soil have impacted groundwater causing exceedance of action levels, then the vertical and horizontal extent of groundwater exceedance will be evaluated.
13. If action levels or background concentrations are exceeded for the media of a site unit, then the risk assessment will be initiated, based on sample results, acceptable levels of risk, and potential land uses, to assess potential risks to human health and/or the environment.
14. If unacceptable risks are assessed to human health or the environment, then cleanup levels will be evaluated for each media.
15. If cleanup levels in a given medium are exceeded, and if the site meets at least one of the eight criteria for removal action described in 40 *Code of Federal Regulations* (CFR) 300.415(b)(2), and the scale and complexity of contaminant distribution in the affected medium are such that excess risk can be expediently reduced utilizing readily available technology, then the medium at the site will be recommended for Early Action.
16. If an early removal action is selected, a non-time-critical EE/CA and Action Memorandum will be completed for the removal action.

17. Once the removal action is completed, the site will be evaluated for residual risk. If a residual risk exists, then a Long-Term Action may be required.

18. If cleanup levels for a given medium are exceeded, and if the site does not meet criteria for an Early Action, then the affected medium will be recommended for long-term remedial action as part of the RI/FS process; and an FS will be completed, followed by a Record of Decision, Remedial Design, and Remedial Action to clean up the site for closure.

STEP 6 – SPECIFY LIMITS ON UNCERTAINTY

The purpose of Step 6 is to specify the tolerance limits for decision errors, which are used by the decision makers to establish performance goals for the data collection design. The objective of the data collection design is to obtain data that reliably estimate the true nature of environmental conditions at Site 12. This process is presented in Section 4 of the Work Plan. The following information documents this process for Site 12.

Identify the Null Hypothesis and Specify the Decision Errors

The null hypothesis for this site specifies that the concentrations of one or more of the COPCs exceed PRGs or risk-based action levels and represent an unacceptable risk at the site.

The alternative hypothesis for this site specifies that the concentrations of one or more of COPCs do not exceed PRGs or risk-based actions levels and represent an acceptable risk at the site.

The false-positive and false-negative decision errors are discussed in Section 4 of the Work Plan.

Decision Error Limits

For the Phase II RI/FS, the allowable probability of making a false-positive decision has been designated as 0.05 (confidence of 95 percent) and an allowable probability of making a false-negative decision error has been designated as 0.20 (power of 80 percent).

Calculating the Number of Samples Necessary to Determine Risk

The number of sample locations necessary to determine the risk at a unit or a site were estimated using the process presented in Section 4 of the Work Plan. The number of additional sample locations needed to assess risk during the Phase II RI/FS is the difference between the total number of sample locations and the number of locations sampled during the Phase I RI (Table L-1).

Table L-1
Summary of Phase II RI/FS OU-3 Soil Sampling Strategies

Description	Unit Area	Estimated Risk[a]	Number of Locations/ Samples[b]	Number of Phase I Locations/ Samples	Number of Phase II Locations/ Samples	Tier	Type of Sampling Strategy
Site 12–Sludge Drying Beds	Unit 1–63,800 ft^2	3×10^{-5} (0.97)	6(18)	4(10)	2(8)	1	Stratified Random: partial area
	Unit 2–34,300 ft^2	3×10^{-6} (0.47)	12(36)	4(9)	2(8)[c]	1	Stratified Random: partial area
					2(8)	1	Judgmental–per regulators
					1(3)	1	Judgmental–at tar spot
	Unit 4–108,800 ft^2	—	8(24)	9(18)	8(32)	1	Judgmental–per regulators

Notes:

[a] These estimated cumulative cancer risk values were developed using Phase I RI data, and COPC-specific risk-based concentrations were developed following completion of Phase I RI activities. Numbers in parentheses are the estimated hazard index values.

[b] Number of samples based on comparison of estimated cancer risk to Table 4-7 in Phase II RI/FS Work Plan, which correlates four cancer-risk categories to the number of samples needed to determine that risk using the project-specific power and confidence limits. For this column, the first number represents sample locations, and the second number (in parentheses) is the number of samples based on an average of three depth intervals per sample location.

[c] These numbers represent the difference between the number of samples required to determine risk and the number of samples collected as part of the Phase I RI, with the following provisions:
Where Phase II RI/FS sample locations were recommended to determine risk, the area covered by this number of locations was based upon the U.S. EPA risk determination standard of a 40- x 40-meter block per sample location. This corresponds to an area of about 206,700 $feet^2$ for 12 sample locations. If the unit area is greater than this size limit, the maximum specified number of samples, less the Phase I RI number of samples, will be collected during the Phase II RI/FS. If the unit area is less than this size limit, the number of sample locations represents a ratio of the unit area versus the 12-sample area (206,700 $feet^2$) times 12 (e.g., Site 19, Unit 3: [Unit 3 area/206,700 $feet^2$]) x 2 locations = 9 locations needed - 3 Phase I locations = 6 new Phase II RI/FS locations required. Use of this ratio rule should maintain the necessary power and confidence limits at units where fewer samples are collected. At units where the ratio rule is applied, the total number of samples (Phase I and Phase II combined) will never be less than six despite the ratio calculation, to be sure that the minimum number of sample locations necessary for a risk assessment is collected. The number of Phase II RI/FS shallow soil boring locations has been based on three samples per location. However, at Site 8 (Unit 3) and Site 12 (Units 1, 2, and 4), four samples per location will be collected.

Sampling Designs for the Operable Unit-3 Sites

Three types of sampling designs will be used to determine the soil conditions at Site 12. These sampling designs are as follows:

- stratified random sampling (either whole or partial unit areas, with replacement where sample locations are closely spaced or overlap);
- systematic random sampling along an axis (with replacement if new and existing sample locations overlap or are closely spaced); and
- judgmental sampling.

A description of these Phase II RI/FS sampling designs is presented in Section 4 of the Work Plan. The first two sampling designs utilize random positioning to produce an unbiased configuration of sample locations. The advantage of a random, unbiased sampling design is that the tolerance limits for false-positive and false-negative decision errors can be applied to the sample data and the risk decisions can be assigned a level of confidence.

The third sampling design used is judgmental sampling. Judgmental sampling is designed to provide answers to a more specific questions or issues where considerable information on a population already existing. Confidence and power limits associated with statistically based sampling designs do not apply to judgmentally located samples. Decision errors must still be considered for judgmental samples; however, they will not be evaluated statistically. The decision errors associated with judgmental sampling are based on sample design errors and measurement errors. Assuming the best possible professional judgment was used to position the judgmental sample locations using existing data for the site, the most important decision errors will be associated with field and laboratory techniques involved with collection of the data. This makes careful application of field and laboratory techniques even more critical, due to the fact that corroborative data from multiple sample locations will not statistically evaluated.

STEP 7 – OPTIMIZE THE DESIGN

Historic site activities, previous site investigation results, and regulatory comments were used to formulate the Phase II RI/FS sampling approach. Shallow and deeper subsurface soils will be investigated at this site using a tiered sampling approach. This sampling approach consists of three tiers:

- The main focus of the Tier 1 sampling plan will be to determine whether the unit is a risk. The Tier 1 sampling approach will consist of collecting shallow soil samples (less than 10 feet bgs) from a specific number of sampling locations within the unit. The number of sampling locations has been proposed such that when the Phase I and II RI/FS data are evaluated together, an assessment of risk can be completed for the unit.

- The Tier 2 sampling approach will also focus on shallow soil; however, the primary objective will be to refine the extent of shallow soil that has been impacted by site activities, by focusing on subareas of the unit where COPCs exceeded PRGs as identified by the Tier 1 sampling and/or Phase I RI/FS results.
- The Tier 3 sampling approach has been designed to estimate the horizontal and vertical extent of impacted subsurface soil (greater than 10 feet bgs). This sampling strategy will only be implemented if Phase I RI/FS soil sample analytical data or Phase II RI/FS Tier 1/Tier 2 soil sample analytical data suggest impacted soil exists at depths greater than 10 feet bgs. Groundwater will be investigated if Phase I or Phase II soil data indicate potential impacts to groundwater are possible.

The tiered sampling approach is detailed in the following sections and in the FSP, Attachment L (BNI 1995).

Tier 1

The Tier 1 of sampling will be collection of shallow samples from each unit within the site as described below. For a list of all soil samples and analysis for Site 12 see Table L-2.

TIER 1 SOIL SAMPLING

Tier 1 sample locations within the three units will be positioned using systematic random sampling on an axis, stratified random sampling, or judgmental designs to support the risk assessment and to characterize additional areas not sampled as part of the Phase I RI (Figure L-2).

Unit 1: West Sludge Drying Beds

The objectives of this investigation are to confirm Phase I RI results and to collect data to support a risk assessment so a recommendation for NFI or Early Action can be made.

During the Phase I RI, five locations were sampled in Unit 1. The analytical results of soil samples indicate benzo(a)pyrene, benzo(a)anthracene, benzo(a)fluoranthene, dieldrin, and Aroclor 1254 exceed PRGs; and benzo(a)pyrene, DDE, lead, mercury, and zinc exceed ecological screening criteria.

In the Phase II RI/FS, Tier 1 soil samples will be collected at 0, 2, 5, and 10 feet bgs at two stratified random sampling locations. All soil samples will be field screened for polynuclear aromatic hydrocarbons (PAH) by immunoassay test kits (U.S. EPA Method 4035) and for TAL metals (U.S. EPA Method 6000/7000) by using an appropriately equipped mobile laboratory. All soil samples will be analyzed by a fixed-base laboratory for pesticides/PCB (U.S. EPA Method 8080), cyanide (U.S. EPA Method 335.2) and herbicides (U.S. EPA Method 8150) under NEESA Level D protocols.

Table L-2
Soil Sampling and Analysis

Tier	Unit/Name	PHASE II RI/FS SAMPLE NUMBERS			FIELD[a] - IMMUNOASSAY OR MOBILE LABORATORY					OFF-SITE LABORATORY[b]		
		No. of Locations	Samples/ Location	Total Samples	PAH[c]	PCBs[c]	VOCs[c]	TPH Gas and Diesel[d]	Target Analyte List - Metals[d]	PCBs and Pesticides	Herbicides	Others: Cyanide
Tier 1	Unit 1 - West Sludge Drying Beds	2	4	8	X				X	X	X	X
	Unit 2 - East Sludge Drying Beds	2 random, 2 judge	4	16	X				X	X	X	X
	Unit 4 - Former WWTP	8	4	32	X				X	X		
	Tier 1 Subtotals			56	56				56	56	31	56
Tier 2	Optional: Scope of Tier 2 would be to define extent of shallow soil contamination; based on Tier 1 data, Phase I RI findings, and RFA data, with approval of BCT											
Tier 3	Optional: Scope of Tier 3 would be to characterize horizontal and vertical extent of contamination below 10 feet depth; based on Tier 1 and 2 data, Phase I RI findings, soil gas survey results, and/or RFA data, with approval of BCT											

Notes:
[a] Three samples from Units 1, 2, and 4 go to the off-site laboratory for confirmation analyses.
[b] These constituents cannot be determined in the field; all samples to be analyzed for these constituents will be sent to the off-site laboratory.
[c] immunoassay analyses
[d] mobile laboratory analyses

For quality assurance/quality control (QA/QC) support and verification, three samples (two detects and one nondetect) will be submitted to the fixed-base laboratory to confirm field screening results. The fixed-base analyses are PAH (U.S. EPA Method 8310), and TAL metals (U.S. EPA Method 6000/7000) under NFESC Level D protocols. Attachment L in the FSP provides the sampling procedures for the Phase II RI/FS at Site 12, Unit 1 (BNI 1995).

Unit 2: East Sludge Drying Beds

The objectives of this investigation are to confirm Phase I RI results and to collect data to support a risk assessment so a recommendation for NFI or Early Action can be made.

During the Phase I RI, three locations were sampled in Unit 2. The analytical results of soil samples indicate Aroclor 1254 exceed PRGs; and DDE, DDT, and lead exceed ecological criteria.

In the Phase II RI/FS, Tier 1 soil samples will be collected at 0, 2, 5, and 10 feet bgs at two stratified random sampling locations within the sludge base and two judgmental sampling locations (two small impoundments. All soil samples will be field screened for PAH by immunoassay test kits (U.S. EPA Method 4035) and TAL metals (U.S. EPA Method 6000/7000) by an appropriately equipped mobile laboratory. All soil samples will be analyzed by a fixed-base laboratory for pesticides/PCB (U.S. EPA Method 8080), cyanide (U.S. EPA Method 335.2), and herbicides (U.S. EPA Method 8150) under NFESC Level D protocols. For QA/QC support and verification, three samples (two detects and one nondetect) will be submitted to the fixed-base laboratory to confirm field screening results. These fixed-base analyses are PAH (U.S. EPA Method 8310) and TAL metals (U.S. EPA Method 6000/7000) under NFESC Level D protocols. Attachment L in the FSP provides the sampling procedures for the Phase II RI/FS at Site 12, Unit 2 (BNI 1995).

Unit 3: Drainage Ditch - Tier 2

Unit 3 has been approved for Early Action and is being addressed through the Non-Time-Critical Removal Action process. An Engineering Evaluation/Cost Analysis will be prepared for this unit.

Unit 4: Former Wastewater Treatment Plant

The objectives of this investigation are to confirm the RFA results and to collect data to support a risk assessment so a recommendation for NFI or Early Action can be made.

During the RFA, 10 locations were sampled in Unit 4. The analytical results of soil samples indicate benzo(a)pyrene, Aroclor 1260, and arsenic exceed PRGs; and benzo(a)pyrene, DDE, arsenic, copper, mercury, and zinc exceed ecological criteria.

In the Phase II RI/FS, tier 1 soil samples will be collected at 0, 2, 5, and 10 feet bgs at eight judgmental random sampling locations. All soil samples will be field screened for PAH by immunoassay test kits (U.S. EPA Method 4035), for total petroleum hydrocarbons (TPH) (U.S. EPA Method 8015M), and TAL metals (U.S. EPA Method

6000/7000) by an appropriately equipped mobile laboratory. All soil samples will be analyzed by a fixed-base laboratory for pesticides/PCB (U.S. EPA Method 8080), cyanide (U.S. EPA Method 335.2), and herbicides (U.S. EPA Method 8150) under NFESC Level D protocols. For QA/QC support and verification, three samples (two detects and one nondetect) will be submitted to the fixed-base laboratory to confirm field screening results. The fixed-base analyses are PAH (U.S. EPA Method 8310), TPH (U.S. EPA Method 8015M), and TAL metals (U.S. EPA Method 6000/7000) under NFESC Level D protocols. Attachment L in the FSP provides the sampling procedures for the Phase II RI/FS at Site 12, Unit 4 (BNI 1995).

Tier 2

The primary objective of the Tier 2 sampling program is to refine the extent of impacted soil identified within each unit by Phase I and/or II RI/FS sampling results. The Tier 2 sampling program will focus exclusively on shallow soil (0 to 10 feet depth) conditions and will further investigate subareas within the unit boundary that exceed PRGs.

The Tier 2 sampling plan will be developed after an evaluation of Phase I RI/FS and/or Phase II RI Tier 1 analytical results. If a Tier 2 sampling program meets the DQOs for this unit, the decision to proceed will be based upon the criteria described in DQO Steps 2, 3, and 5. The proposed Tier 2 sampling plan, with recommendations, will be reviewed by the BCT. The BCT will decide whether the proposed Tier 2 sampling program will be implemented by the Navy.

TIER 2 SOIL SAMPLING

As noted, the objective of a Tier 2 sampling program is to refine the extent of impacted shallow soil within the unit being investigated. The rationale for accomplishing this objective depends primarily on the size and layout of the unit. Where the unit is a linear feature such as a drainage ditch, the Tier 2 program will focus sampling along the trend of the ditch bracketing the Tier 1 sampling locations (or Phase I RI/FS sample locations) where analyte concentrations exceeding PRGs are reported.

For units of rectangular, roughly circular, or irregular dimensions, a systematic random sampling based on a grid, stratified random sampling, or judgmental sampling approach will be used to define the extent of the Tier 1 sample location(s) where analyte concentrations exceeded PRGs. The limits of the area covered by these sampling approaches will be contingent upon the distribution of adjacent Tier 1 sample locations in which the COPCs were not detected.

The number of Tier 2 sampling locations (i.e., grid spacing) will be selected to achieve the following objectives:

- provide the areal coverage necessary to define the extent of shallow impacted soil; and
- minimize the cost associated with field and fixed-base laboratory sample testing.

The spacing between sampling locations for Tier 2 will be contingent upon the estimated size of the area to be investigated, and the spacing between Phase I or II RI/FS sample locations. Tier 2 soil sample depth intervals and chemical analyses will conform to those specified for Tier 1 soil sampling.

Tier 3

The Tier 3 sampling program would only be implemented at a unit where Phase I RI data, or the initial evaluation of the Phase II RI Tier 1 and/or Tier 2 sampling program results suggest that soil contamination may extend to depths greater than 10 feet bgs.

The objectives of the Tier 3 sampling program are to estimate the horizontal and vertical extent of impacted subsurface soil (greater than 10 feet bgs) and assess whether groundwater beneath the site has been impacted by historic site activities. If impacted subsurface soil is limited to the vadose zone above the water table or vadose zone modeling does not suggest a potential for COPCs to impact groundwater, then groundwater quality will not be investigated.

The Tier 3 sampling plan will be developed after an evaluation of Phase I RI/FS and Phase II RI Tier 1 and/or 2 analytical results. If a Tier 3 sampling program meets the DQO for this unit, then the decision to proceed will be based upon the criteria described in DQO Steps 2, 3, and 5. The proposed Tier 3 sampling plan, with recommendations, will be reviewed by the BCT. The BCT will decide whether the proposed Tier 3 sampling program will be implemented.

Optimization of Sampling Plan

As soil analytical data become available from sampling in each unit, investigative plans for the site will be optimized. The proposed tiered sampling approach is an iterative process, that will permit data from one tier to be evaluated prior to the implementation of the next tier of sampling. The iterative process involves review of data, recommendations for further actions, and approval of the BCT. In this way, the investigation can be optimized by performing the least amount of sampling necessary to assist the decision making process about future actions at the unit (i.e., NFI, Early Action, and Long-Term Action).

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U.S. EPA. *See* United States Environmental Protection Agency.

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WORK PLAN APPENDIX M

DATA QUALITY OBJECTIVES
OPERABLE UNIT 3 –
SITE 13 – OIL CHANGE AREA

SUMMARY

Site 13 is designated as a Removal Action site. Units 1 and 2 at Site 13 are considered under this Removal Action site. Site 13 was designated for the Removal Action in June 1995. Because Site 13 is in the Removal Action process, it will not be addressed in this Phase II Remedial Investigation/Feasibility Study. The background information provided in this appendix has been presented to provide an understanding of the Site 13 history prior to its inclusion in the Removal Action process. Site 13 is designated as a Non-Time-Critical Removal Action, and an Engineering Evaluation/Cost Analysis and Action Memorandum are being prepared for the site.

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ACRONYMS/ABBREVIATIONS

AOC	area of concern
bgs	below ground surface
COPC	chemical of potential concern
FS	Feasibility Study
LUFT	(California) Leaking Underground Fuel Tank (Field Manual)
MCAS	Marine Corps Air Station
MCL	maximum contaminant level
µg/kg	micrograms per kilogram
µg/L	micrograms per liter
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
PCB	polychlorinated biphenyl
PRG	(U.S. EPA Region IX) Preliminary Remediation Goal
RCRA	Resource Conservation and Recovery Act
RFA	RCRA Facilities Assessment
RI	Remedial Investigation
RI/FS	Remedial Investigation/Feasibility Study
SAIC	Science Applications International Corporation
SVOC	semivolatile organic compound
SWMU	solid waste management unit
TAL	target analyte list
TDS	total dissolved solids
TFH	total fuel hydrocarbons
TRPH	total recoverable petroleum hydrocarbons
U.S. EPA	United States Environmental Protection Agency
UST	underground storage tank
VOC	volatile organic compound

Appendix M
SITE 13 – OIL CHANGE AREA

SITE DESCRIPTION

Site 13 encompasses about 1/4 acre north of Building 242 in the southwest corner of Marine Corps Air Station (MCAS) El Toro (Figure M-1). Site boundaries for the MCAS El Toro Phase I Remedial Investigation (RI) were determined by consensus between the Navy and the regulatory agencies prior to initiation of the Phase I RI. Areas of concern were generally grouped together into sites based on their common historical activities, the aerial photograph reviews, and their respective locations to one another.

For the Phase I RI, Site 13 was divided into two strata: Stratum 1 comprised the area located southeast of Tank Farm No. 2, and Stratum 2 comprised the area located southwest of Tank Farm No. 2. Vehicles and equipment were driven to the area of Stratum 1 for oil changes with crank case oil frequently drained onto the ground. This activity was a common practice as evidenced by well-defined stains observed in the historical aerial photographs. From 1977 to 1983, approximately 7,000 gallons of waste oil were drained onto the ground. The oily soil was subsequently removed; thus, no visible evidence of the oily soil remains.

A review of aerial photographs also indicate heavy staining throughout the area of Stratum 2, which persisted throughout the years of photographic record. It is likely that oil changes have been conducted there as well (Jacobs Engineering 1993a).

Previous Investigations

Several investigations have been conducted at Site 13. These include the Resource Conservation and Recovery Act (RCRA) Facilities Assessment (RFA), the Phase I RI, the aerial photographic surveys, and employee interviews. The sections below provide a brief summary of these investigations.

RCRA FACILITIES ASSESSMENT

The RFA identified three solid waste management units(SWMUs)/areas of concern (AOCs) within the Site 13 boundaries. These are SWMU/AOC 67 (Drum Storage area), SWMU/AOC 217 (underground storage tank [UST]), and SWMU/AOC 218 (Oil/Water Separator). During the RFA, these areas were not sampled because their investigation was deferred to the Phase I RI/Feasibility Study (FS). The three SWMU/AOCs are located within Stratum 1 (Jacobs Engineering 1993b).

SWMU/AOC 67 is being evaluated under the MCAS El Toro RFA Closure Program. It is anticipated that both SWMU/AOCs 217 (UST) and 218 (Oil/Water Separator) will be evaluated under the MCAS El Toro UST Investigation.

PHASE I REMEDIAL INVESTIGATION

For the Phase I RI, subareas within sites were designated as strata. Due to the fact that some new subareas have been added or subareas have been expanded or diminished for the Phase II RI/FS, subareas within sites will be referred to as units for the Phase II RI/FS. In this section, discussion is related to Phase I RI sampling and results and the term strata will be used. Following this section, the term unit will be used.

During the Phase I RI, Site 13 was divided into two strata (Figure M-2):

- Stratum 1 consisted of the Area Southeast of the Tank Farm No. 2; and
- Stratum 2 consisted of the Area Southwest of Tank Farm No. 2.

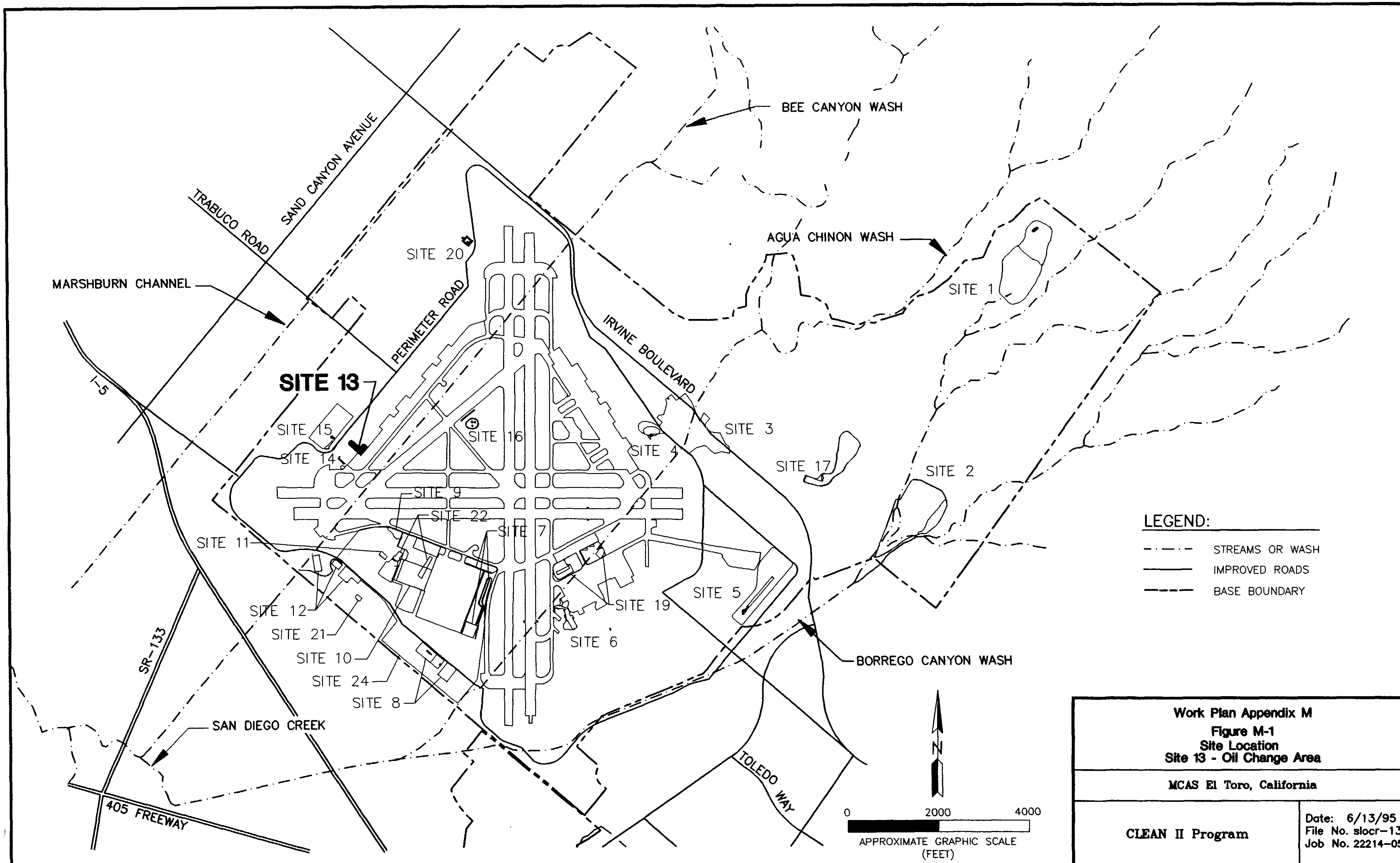
The following site specific activities were conducted:

- shallow soil samples (0 to 10 feet below ground surface [bgs]) were collected from three locations in each stratum;
- soil samples were collected from one deep boring;
- two borings were drilled sampled and one was completed as a downgradient monitoring wells and one as an upgradient monitoring well; and
- soil samples were analyzed for volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), total recoverable petroleum hydrocarbons (TRPH), total fuel hydrocarbons (TFH), target analyte list (TAL) metals; and
- groundwater samples were analyzed for VOCs, SVOCs, TRPH, TFH, TAL metals, pesticides and polychlorinated biphenyls (PCBs), general chemistry.

A summary of the ranges of analyte concentrations detected during the Phase I RI, plus recent groundwater monitoring data is presented below. All chemicals of potential concern (COPCs) that were detected in soil are listed with the exception of specific metals which are listed only if United States Environmental Protection Agency (U.S. EPA) Region IX Preliminary Remediation Goals (PRGs) or ecological screening criteria in shallow soil were exceeded. All COPCs exceeding PRGs or maximum contaminant levels (MCLs) in groundwater are included in this list. If a minimum concentration is recorded with a "less than" symbol, it denotes a concentration below the contract laboratory program detection limit. Sample locations are shown on Figure M-2. A complete listing of all detected chemicals is presented in the Phase I RI Technical Memorandum, Appendix B-13, Tables B13-2 through B13-7, (Jacobs Engineering 1993a), and in the Groundwater Quality Data Report (Jacobs Engineering 1994a). TAL metals that were analyzed during the Phase I RI are beryllium, barium, arsenic, antimony, aluminum, cadmium, calcium, cobalt, copper, iron, lead, magnesium, manganese, mercury, nickel, potassium, selenium, silver, sodium, thallium, vanadium, and zinc.

Shallow Soil (less than 10 feet below ground surface)

- metals: lead (1.8 to 250 milligrams per kilogram [mg/kg]), mercury (< 0.03 to 0.55 mg/kg) and 20 of 23 TAL metals;
- VOCs: acetone (< 0 to 43 micrograms per kilogram [μg/kg]), toluene (< 11 to 8J μg/kg);



Work Plan Appendix M
Figure M-1
Site Location
Site 13 - Oil Change Area

MCAS El Toro, California

CLEAN II Program

Date: 6/13/95
File No. slocr-13
Job No. 22214-059

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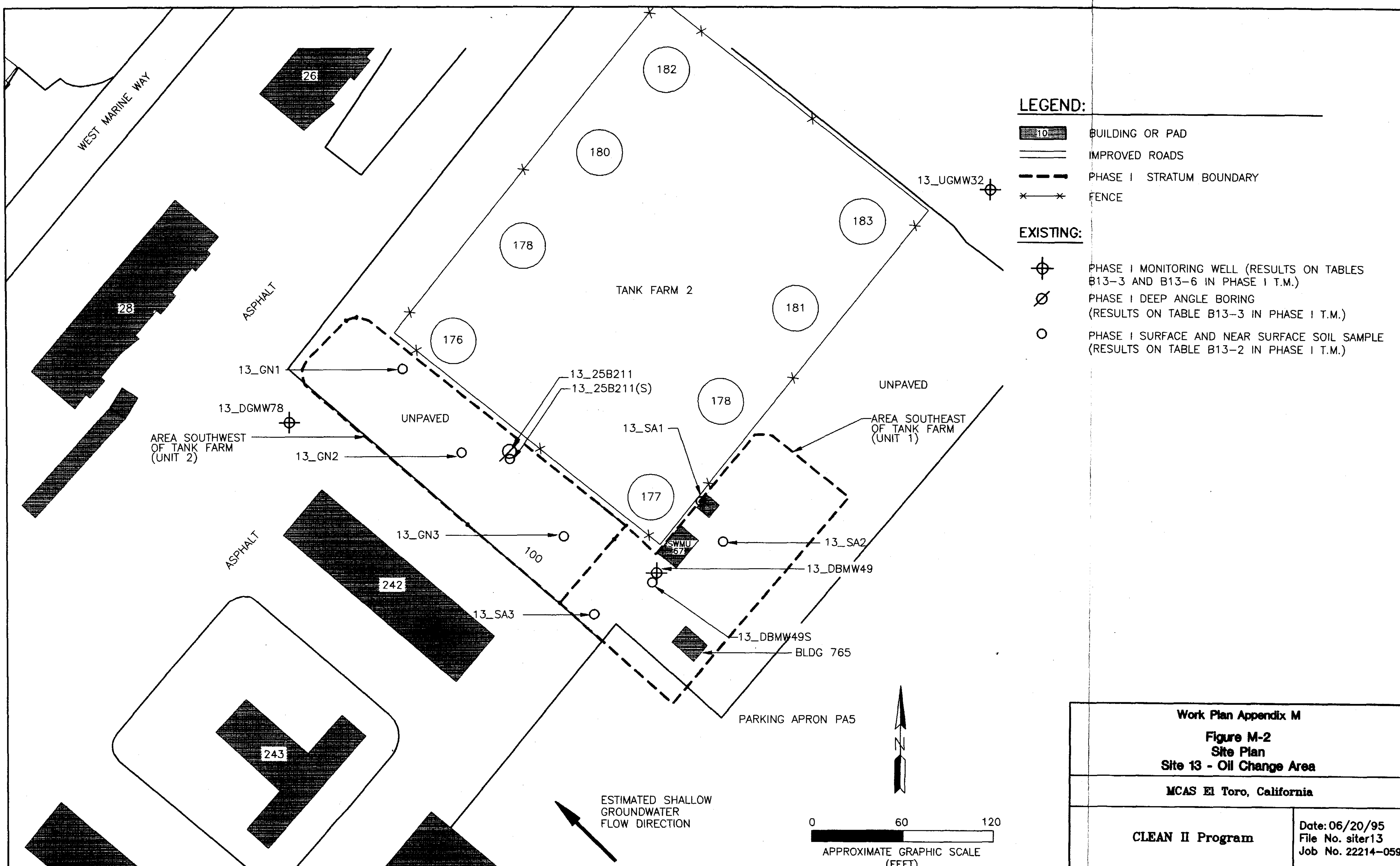

Work Plan Appendix M

Figure M-2
Site Plan
Site 13 - Oil Change Area

MCAS El Toro, California

CLEAN II Program

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File No. siter13
Job No. 22214-059

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- SVOCs: benzo(a)pyrene (< 670 to 210J µg/kg), benzo(b)fluoranthene (< 670 to 260J µg/kg), benzo(g,h,i)perylene (< 670 to 200J µg/kg), benzo(k)fluoranthene (< 670 to 190J µg/kg), benzyl butyl phthalate (< 670 to 160J µg/kg), bis(2-ethylhexyl) phthalate (< 670 to 270J µg/kg), chrysene (< 670 to 210J µg/kg), fluoranthene (< 670 to 330J µg/kg), indeno(1,2,3-cd)pyrene (< 670 to 230J µg/kg), phenanthrene (< 670 to 200J µg/kg), pyrene (< 670 to 270J µg/kg); and
- fuel and petroleum hydrocarbons: TFH-diesel (< 12.5 to 490 mg/kg), TFH-gasoline (< 0.052 to 0.319 mg/kg), TRPH (< 16 to 3,340 mg/kg).

Subsurface Soil (greater than 10 feet below ground surface)

- metals: 22 TAL metals;
- VOCs: 2-butanone (< 10 to 5J µg/kg), acetone (< 10 to 120DB µg/kg), benzene (< 10 to 6J µg/kg);
- SVOCs: bis(2-ethylhexyl)phthalate (< 680 to 260J µg/kg);
- pesticides and PCBs: 4,4-dichlorodiphenyldichloroethane (< 3.83 to 6.69 µg/kg), 4,4-dichlorodiphenyltrichloroethane (< 3.69 to 12.5 µg/kg), BHC-delta (< 1.93 to 5.03 µg/kg), endosulfate sulfate (< 3.44 to 5.77 µg/kg), endrin ketone (< 3.44 to 5.2 µg /kg); and
- fuel and petroleum hydrocarbons: TFH-diesel (< 12.7 to 109J mg/kg), TFH-gasoline (< 0.051 to 0.241 mg/kg), TRPH (< 20 to 1,605 mg/kg).

Groundwater (13_UGMW32 Upgradient)

- general chemistry: chloride (161 to 184 milligrams per liter [mg/L]), sulfate (511 to 554 mg/L), total dissolved solids (TDS) (1,490 to 1,540 mg/L);
- metals: antimony (17.4B to 25.6 micrograms per liter [µg/L]), selenium (19.3 to 30.8 µg/L), manganese (85.5 to 197µg/L);
- VOCs: 1,1,1-trichloroethane (< 1 to 0.5J µg/L), benzene (15 to 730 µg/L), toluene (< 1 to 2 µg/L), xylenes (3 to 58 µg/L);
- SVOCs: bis(2-ethylhexyl)phthalate (4J to 26 µg/L); and
- fuel and petroleum hydrocarbons: TFH-diesel (< 250 to 308 µg/L), TFH-gasoline (297J to 1,690 µg/L).

Groundwater (13_DBMW49 On-Site)

- general chemistry: chloride (318 to 346 mg/L), nitrate/nitrite (11.8 to 15 mg/L), TDS (2,020 to 2,250 mg/L);
- metals: antimony (16.9B to 19.5B µg/L), manganese (87.9 to 99.2 µg/L), selenium (21.4B to 41 µg/L);
- VOCs: benzene (7 to 23 µg/L);

- SVOCs: bis(2-ethylhexyl)phthalate (< 10 to 5J μg/L); and
- fuel and petroleum hydrocarbons: TFH-diesel (< 250 to 3,370 μg/L), TFH-gasoline (68.1 to 216J μg./L).

Groundwater (13_DGMW78 Downgradient)

- general chemistry: chloride (394 to 522 mg/L), nitrate/nitrite (26.5 to 28.7 mg/L), TDS (2,570 to 2,910 mg/L);
- metals: aluminum (< 20.7 to 51.9 μg/L), antimony (< 26.1 to 23.7B μg/L), cadmium (6.6 to 8 μg/L), manganese (1,230 to 1,800 μg/L), selenium (< 7 to 152 μg/L);
- VOCs: benzene(12 to 110 μg/L), ethylbenzene (2 to 8 μg/L), xylenes (9 to 26 μg/L); and
- fuel and petroleum hydrocarbons: TFH-diesel (< 250 to 436 μg/L), TFH-gasoline (138 to 445 μg/L).

J =Indicates an estimated value for qualitative use only (organic parameters).

B = Indicates reported value is less than the contract-required detection limit, but greater than the or equal to the instrument detection limit (inorganic parameters).

A comparison of the shallow soil analytical results with previously developed PRGs and ecological screening criteria for COPCs indicate:

- benzo(a)pyrene exceeds its PRG in soil samples collected from within the upper two feet of ground surface;
- benzo(a)pyrene, lead, and mercury exceed the ecological criteria in soil samples collected from within the upper two feet of ground surface; and
- soil samples collected from deeper than two feet bgs did not contain contaminants at concentrations that exceed PRGs or ecological criteria.

Petroleum hydrocarbons detected in shallow soil samples were also compared to Leaking Underground Fuel Tank (LUFT) Field Manual guidelines (LUFT 1989) to evaluate their potential to migrate to the groundwater. Based on LUFT guidelines, petroleum hydrocarbons in shallow soil do not appear to pose a threat to groundwater at this site. Also, no chemicals present in subsurface soil appear to have the potential to reach the groundwater.

Analytical results of groundwater samples collected from one monitoring well (13_DBMW49) located within the boundaries of Stratum 1 and another (13_DGMW78) located immediately downgradient of Stratum 2, indicate:

- concentrations of benzene, antimony, manganese, and nitrate exceed PRGs; and
- benzene, aluminum, antimony, cadmium, chloride, selenium, sulfate, nitrate, manganese, TDS, and bis(2-ethylhexyl) phthalate concentrations exceed primary MCLs.

Analytical results of groundwater samples collected from the upgradient monitoring well (13_UGMW32) indicated the following: benzene, antimony, chloride, selenium, sulfate, manganese, TDS, and bis(2-ethylhexyl) phthalate concentrations exceed primary MCLs.

Benzene and bis(2-ethylhexyl) phthalate were detected at higher concentrations in the upgradient well as compared to the downgradient wells. Nitrate, aluminum, cadmium, manganese, antimony, and selenium were identified at higher concentrations in downgradient well 13_DGMW78 as compared to the upgradient well. Due to the higher concentrations of benzene and bis(2-ethylhexyl) phthalate in the upgradient well, it appears that these compounds may be related to the former Tank Farm No. 2 rather than the Oil Change Area site.

U.S. EPA AERIAL PHOTOGRAPH SURVEY

A heavy stain was observed in the area between Tank Farm No. 2 and Building 242 on photographs from 1952, 1965, and 1970. Also, heavy staining in the area southeast of the Tank Farm No. 2 was evident in 1965 and 1970 photographs. Probable stains were identified in the same location on the 1980 photograph.

SCIENCE APPLICATIONS INTERNATIONAL CORPORATION AERIAL PHOTOGRAPH SURVEY

The Science Applications International Corporation photographs (SAIC 1993) identify stained ground in the southern corner of the site on the 1967 photograph. On the 1971 photograph, a possible vertical tank with a stain on the north side was identified in the southeastern portion of the site. In the 1983 photograph, a unidentified liquid flowing from the northwest corner of Building 1505 (adjacent to the aircraft parking apron) was observed (SAIC 1993).

EMPLOYEE INTERVIEWS

On 26 May 1994, a meeting was held at the MCAS El Toro to interview active and retired personnel from the Station Fuel Operations Division and Facility Management Department (currently the Installations Department) with knowledge of the Station operations and procedures for storage/disposal of hazardous materials and waste. Participating as interviewers during the meeting were agency personnel, Navy and Station personnel, and personnel from the contractors for the Navy and the U.S. EPA. During these interviews the following information pertaining to Site 13 was obtained (Jacobs Engineering 1994b):

- the tanks at Tank Farm No. 2 were believed to name stored JP-4, JP-5, aviation gas, and waste oils;
- Tank Farm No. 2 was closed and turned over to the Station Environmental Office in 1987;

- sludges were pumped from the tanks after the tank farm was closed; and
- carbon tetrachloride was commonly disposed onto the ground at the Oil Change Area (Jacobs Engineering 1994b).

Geology

The geology of Site 13 consists of Quaternary alluvial and marine deposits (Jacobs Engineering 1993a). Holocene deposits consist of fined grained overbank deposits and some coarse-grained stream channel deposits. These soils are derived from the Santa Ana Mountains to the east and conformably overlie Pleistocene interbedded fine-grained lagoonal and near-shore marine deposits. Pleistocene deposits could not be differentiated from Holocene deposits in Phase I RI soil borings. Pleistocene deposits unconformably overlie semiconsolidated marine sandstones, siltstones, and conglomerates of late Miocene to late Pliocene, which are considered to be bedrock in the area.

Based on a review of boring logs from the Phase I RI, subsurface lithology at Site 13 consists mainly of silt, with minor amounts of sand and gravel. However, the log of well 13DGMW78 shows mainly sand interbedded with clay, silt, and gravel. A detailed description of the hydrogeology of the MCAS El Toro is described in Section 1.3.8 of the Phase RI Technical Memorandum (Jacobs Engineering 1993a).

Hydrogeology

MCAS El Toro lies within the Irvine Groundwater Basin, which is a subbasin of the Los Angeles groundwater basin. Regional aquifers in the Irvine Subbasin tend to be composed of discontinuous lenses of clayey and silty sands and fine grained gravels contained within a complex assemblage of sandy clays and sandy silts. Three general aquifer systems have been identified near the Station: a shallow and perched system, a principal aquifer zone, and a lower hydrogeologic system existing in bedrock (Jacobs Engineering 1993a).

The Phase I RI results indicate that the shallow, perched zone is not present at Site 13. The principal aquifer is present beneath Site 13 at a depth of 130 feet bgs. The regional groundwater flow direction in the area of the site is to the northwest. The local hydraulic gradient has been influenced strongly by the pumping of irrigation wells located west of MCAS El Toro.

Removal Action

In meetings with the Base Realignment and Closure (BRAC) Cleanup Team during June 1995, Site 13 was designated as a Removal Action site. This designation occurred because the nature and extent of contaminants is known and criteria of a non-time-critical Removal Action were satisfied. An Engineering Evaluation/Cost Analysis, Action Memorandum, and community relations are being prepared for this Removal Action.

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WORK PLAN APPENDIX N

DATA QUALITY OBJECTIVES
OPERABLE UNIT 3 –
SITE 14 – BATTERY ACID DISPOSAL AREA

SUMMARY

Site 14 is designated as a Removal Action site. Presently, Unit 1 (which consists of the entire site) at Site 14 is included under the Removal Action. Because Site 14 is in the Removal Action process, it will not be addressed in this Phase II Remedial Investigation/Feasibility Study. The background information has been presented in the appendix to provide an understanding of the Site 14 history prior to its inclusion in the Removal Action Process. Site 14 is being handled as a Non-Time-Critical Removal Action, and an Engineering Evaluation/Cost Analysis and Action Memorandum are being prepared for the site.

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ACRONYMS/ABBREVIATIONS

BRAC	Base Realignment and Closure
COPC	chemical of potential concern
FS	Feasibility Study
LUFT	(California) Leaking Underground Fuel Tank (Field Manual)
MCAS	Marine Corps Air Station
MCL	maximum concentration levels
µg/kg	micrograms per kilogram
µg/L	micrograms per liter
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
PRG	(U.S. EPA Region IX) Preliminary Remedial Goal
RI	Remedial Investigation
RI/FS	Remedial Investigation/Feasibility Study
SAIC	Science Applications International Corporation
SVOC	semivolatile organic compound
TAL	target analyte list
TDS	total dissolved solids
TFH	total fuel hydrocarbons
TRPH	total recoverable petroleum hydrocarbons
U.S. EPA	United States Environmental Protection Agency
VOC	volatile organic compound

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Appendix N
SITE 14 – BATTERY ACID DISPOSAL AREA

Site Description

Site 14 is located approximately 50 feet southwest of Building 245 at the western edge of Marine Corps Air Station (MCAS) El Toro (Figure N-1). The site is relatively level and lies at an elevation of about 270 feet mean sea level. Building 245 was a heavy equipment maintenance shop that is currently empty. Site boundaries for MCAS El Toro Phase I Remedial Investigation (RI) were determined by consensus between the Navy and regulatory agencies prior to initiation of the Phase I RI. Areas of concern were generally grouped together into sites based on common historical activities, areal photograph review, and their respective locations to each other.

No activities are presently taking place at the Site 14. An asphalt parking area extends south of the Building 245 to the edge of the site. Surface drainage is to the south along the pavement to its edge, then down a slight embankment to a drainage ditch south of the site. The ditch goes west to a culvert that drains to Marshburn Channel. A catch basin located near the drainage ditch sampled during Phase I RI. It was found to receive no surface water runoff from the Battery Acid Disposal Area (Jacobs Engineering 1993a).

From 1977 through 1983, fluids from batteries from facility vehicles were drained onto the ground surface, as well as various paints and associated paint wastes. Surface water runoff from washing down the asphalt pad drained south on to the site. The volume of battery acid (sulfuric acid) disposed at the site is estimated to be approximately 210 gallons. According to site history and activities, other suspected contaminants include lead, other priority pollutant metals, waste oils, and solvents from paint products and strippers (Jacobs Engineering 1993b).

Previous Investigations

Several investigations have been conducted in the area of Site 14: the Phase I RI, aerial photograph surveys, and employee interviews. The sections below provide a summary of these investigations.

PHASE I REMEDIAL INVESTIGATION

For the Phase I RI, subareas within sites were designated as strata. Due to the fact that some new subareas have been added or subareas have been expanded or diminished for the Phase II RI/Feasibility Study (FS), subareas within sites will be referred to as units for the Phase II RI/FS. In this section, discussion is related to Phase I RI sampling and results, and the term strata will be used. Following this section, the term unit will be used.

In Phase I RI Site 14 was divided into two strata:

- Stratum 1 - the edge of the pavement (where acid disposal and paint and paint waste were disposed); and
- Stratum 2 - the area of the drainage ditch (located south of the disposal area).

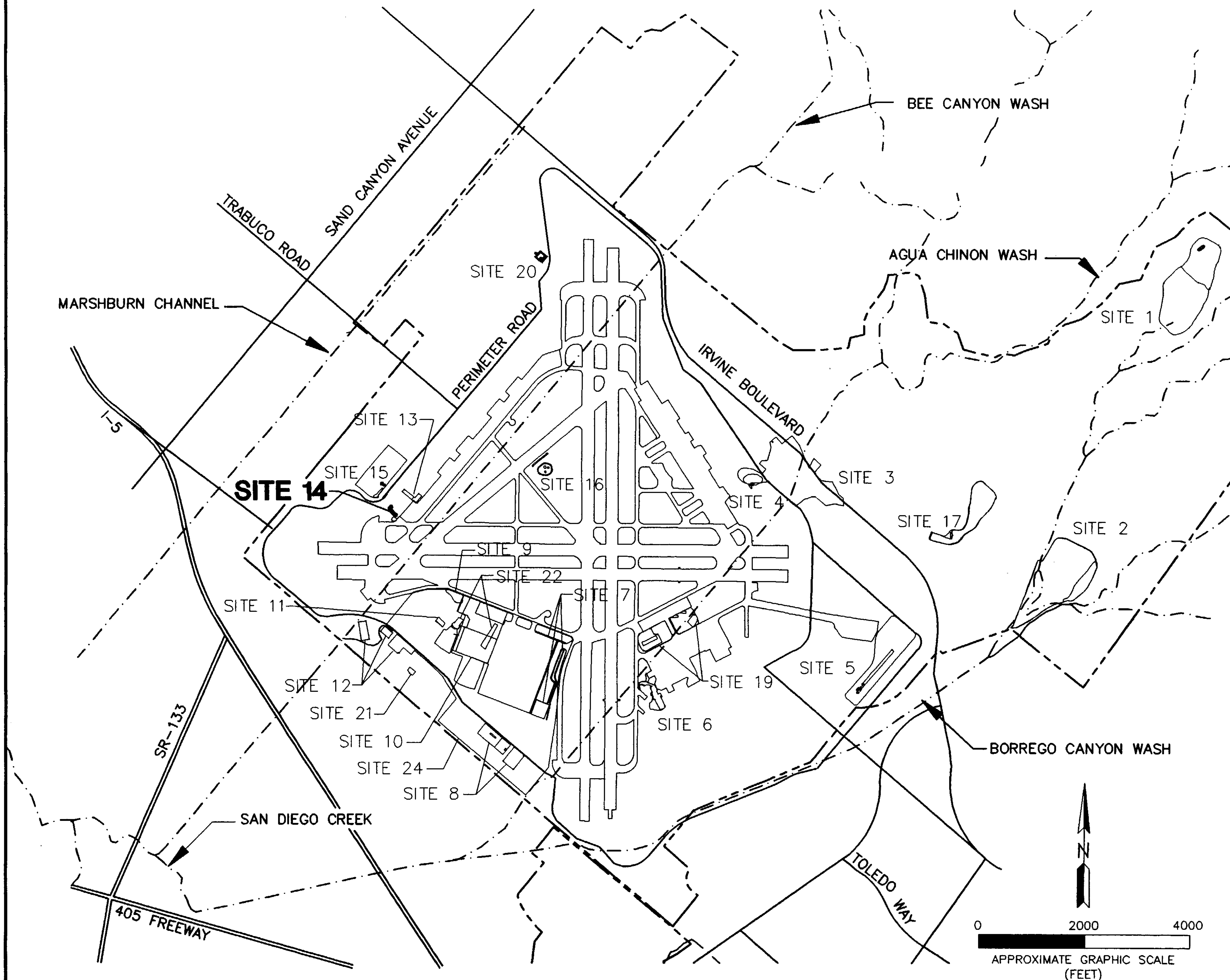
The following activities were conducted as part of the Phase I RI:

- shallow soil samples were collected from eight locations (three each from Strata 1 and 2, one at the deep boring, and one from the Catch Basin);
- one deep boring was drilled, completed as monitoring well, and sampled;
- one deep boring was drilled, completed as a downgradient monitoring well, and sampled;
- soil samples were analyzed for volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), total recoverable petroleum hydrocarbons (TRPH), total fuel hydrocarbons (TFH), target analyte list (TAL) metals; and
- groundwater samples were analyzed for VOCs, SVOCs, TRPH, TFH, TAL metals, pesticides and polychlorinated biphenyls, and general chemistry.

A summary of the ranges of analyte concentrations detected during the Phase I RI, plus recent groundwater monitoring data are presented below. All chemicals of potential concern (COPCs) that were detected in soil are listed with the exception of specific metals, which are listed only if they exceed United States Environmental Protection Agency (U.S. EPA) Region IX Preliminary Remedial Goals (PRGs) or ecological screening criteria in shallow soil. All COPCs that exceed PRGs or maximum contaminant levels (MCLs) in groundwater are included in this list. If a minimum concentration is recorded with a "less than" symbol, it denotes a concentration below the contract laboratory program detection limit. Sample locations are shown on Figure N-2. A complete listing of all detected chemicals is presented in the Phase I RI Technical Memorandum, Appendix B-14, Tables B14-2 through B14-7, (Jacobs Engineering 1993a), and in the Groundwater Quality Data Report (Jacobs Engineering 1994a). TAL metals that were analyzed during the Phase I RI are beryllium, barium, arsenic, antimony, aluminum, cadmium, calcium, cobalt, copper, iron, lead, magnesium, manganese, mercury, nickel, potassium, selenium, silver, sodium, thallium, vanadium, and zinc.

Shallow Soil (less than 10 feet below ground surface)

- metals: barium (59.9 to 303 milligrams per kilogram [mg/kg]), lead (3.1 to 923 mg/kg), zinc (22.6 to 189 mg/kg);
- VOCs: acetone (< 10 to 66 micrograms per kilogram [μg/kg]), carbon tetrachloride (< 10 to 2J μg/mg), toluene (< 10 to 6J μg/kg);
- SVOCs: anthracene (< 670 to 240J μg/kg), bis(2-ethylhexyl) phthalate (< 670 to 7,400 μg/kg), benzo(a)anthracene (< 680 to 2,200 μg/kg), benzo(a)pyrene (< 680 to 3,100 μg/kg), benzo(b)fluoranthene (< 670 to 3,800 μg/kg), benzo(g,h,i)perylene (< 670 to 1,300 μg/kg), benzo(k)fluoranthene (< 680 to 3,100 μg/kg), bis(2-ethylhexyl) phthalate (< 670 to 7,400 μg/kg), carbazole (< 670 to 870 μg/kg), chrysene (< 680 to 3,600 μg/kg), dibenzo(a,h)anthracene (< 680 to 640J μg/kg), fluoranthene (< 680 to 5,800 μg/kg), indeno(1,2,3-cd)



Work Plan Appendix N

Figure N-1
Site Location
Site 14 - Battery Acid Disposal Area

MCAS El Toro, California

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Job No. 22214-059

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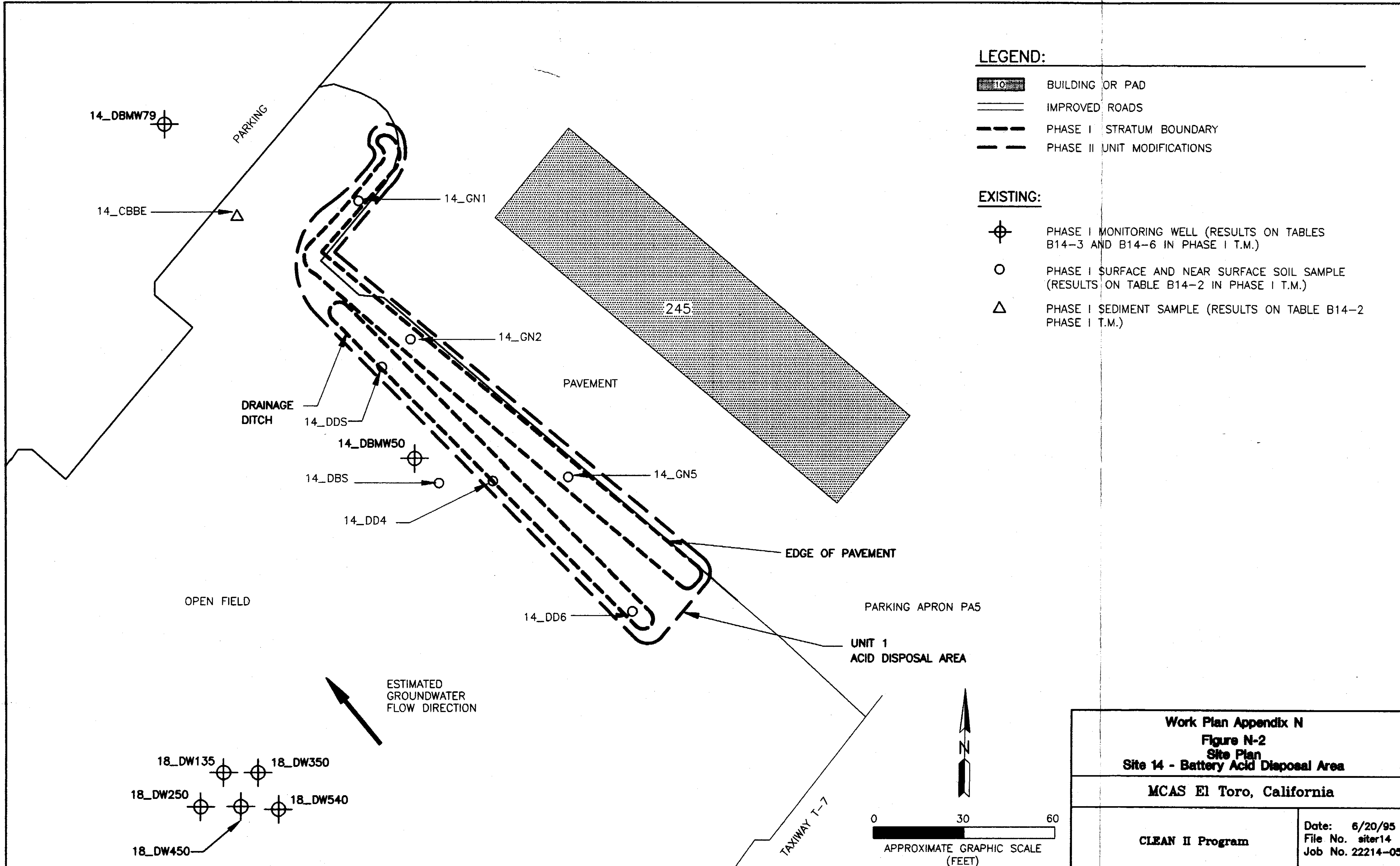

Work Plan Appendix N
Figure N-2
Site Plan
Site 14 - Battery Acid Disposal Area

MCAS El Toro, California

CLEAN II Program

Date: 6/20/95
File No. siter14
Job No. 22214-059

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pyrene (< 680 to 1500 µg/kg), phenanthrene (< 680 to 1,600 µg/kg), pyrene (< 680 to 4,700 µg/kg); and

- fuel and petroleum hydrocarbons: TFH-diesel (< 13 to 11,100 mg/kg), TFH-gasoline (< 0.054 to 1.64 mg/kg), TRPH (< 20 to 7,364 mg/kg).

Subsurface Soil (greater than 10 feet below ground surface)

- metals: 21 of 23 TAL metals;
- VOCs: acetone (< 11 to 16 µg/kg), trichloroethane (< 11 to 3J µg/kg);
- SVOCs: bis(2-ethylhexyl) phthalate (< 730 to 28,000 µg/kg); and
- fuel and petroleum hydrocarbons: TRPH (< 20 to 16 mg/kg).

Groundwater (14_DBMW50 on-site)

- general chemistry: nitrate/nitrite (17.8 to 22.2 milligrams per liter [mg/L]), total dissolved solids (TDS) (1,920 to 2,200 mg/L);
- metals: antimony (< 19.8 to 28B micrograms per liter [µg/L]), manganese (353 to 542 µg/L), selenium (38.4 to 40.8µg/L); and
- VOCs: carbon tetrachloride (19 to 26 µg/L), chloroform (9 to 11 µg/L), trichloroethene (2 to 3 µg/L).

Groundwater (14_DGMW79 downgradient)

- general chemistry: nitrate/nitrite (10.9 to 16.8 mg/L), TDS (2,330 to 2,360 mg/L);
- metals: antimony (< 22.5 to 19B µg/L), manganese (119 to 125 µg/L), selenium (6B to 21.9B µg/L); and
- VOCs: carbon tetrachloride (3 to 5 µg/L), chloroform (9 to 12 µg/L), trichloroethene (1J to 2 µg/L).

J = Indicates an estimated value for qualitative use only (organic parameters).

B = Indicates reported value is less than the contract-required detection limit, but greater than the or equal to the instrument detection limit (inorganic parameters).

Concentrations of COPCs detected in shallow soil at Site 14 during Phase I RI were compared to PRGs and ecological screening criteria (Jacobs Engineering 1993b). The results are stated below:

- Stratum 1: benzo(a)pyrene, benzo(a)anthracene, benzo(k)fluoranthene, dibenzo(a,h)anthracene, indeno(1,2,3-cd)pyrene, and lead exceeded PRGs; benzo(a)pyrene, barium, lead, and zinc exceed ecological criteria; and
- Stratum 2: benzo(a)pyrene, benzo(b)fluoranthene, indeno(1,2,3-cd)pyrene, bis(ethylhexyl) phthalate exceed PRGs; and benzo(a)pyrene, lead, and zinc exceed ecological criteria.

COPCs detected in groundwater samples were compared to PRGs and MCLs:

- carbon tetrachloride, antimony, manganese, and nitrate-N in groundwater exceed PRGs; and
- carbon tetrachloride, antimony, nitrate-N, and selenium exceed primary MCLs.

Petroleum hydrocarbons detected in shallow soil samples were also compared to California Leaking Underground Fuel Tank (LUFT) Field Manual guidelines (LUFT 1989) to evaluate their potential to migrate to groundwater. Based on LUFT guidelines, petroleum hydrocarbons in shallow soil in Strata 1 and 2 do not appear to pose a threat to groundwater at this site.

SCIENCE APPLICATIONS INTERNATIONAL CORPORATION AERIAL PHOTOGRAPH SURVEY

The Science Applications International Corporation aerial photograph survey noted a large open storage area with possible drums on southwest side of Building 246 (Building 246 was located southwest of Building 245). Stained soil was observed on the southeast side of Building 246 in the 1946 photograph. Staining was again observed at the east end of Building 246 in the 1955 photograph. Since battery acid disposal activities did not start until 1977, the observed stains are not related to Site 14 activities (SAIC 1993).

EMPLOYEE INTERVIEWS

On 26 May 1994, a meeting was held at MCAS El Toro to interview active and retired personnel from the Station Fuel Operations Division and Facility Management Department (currently the Installations Department) who have knowledge of Station operations and procedures for storage/disposal of hazardous materials and waste. Participating as interviewers during the meeting were agency personnel, Navy and Station personnel, and personnel from the contractors for the Navy and the U.S. EPA. During these interviews the following information pertaining to Site 14 was obtained (Jacob Engineering 1994b):

- the panel of interviewees did not have any knowledge of why this site may be a source of carbon tetrachloride found in the groundwater; and
- they also confirmed that solvents were used in Building 245 (the former Heavy Duty Maintenance Shop).

Geology

The geology of Site 14 consists of Quaternary alluvial and marine deposits (Jacobs Engineering 1993a). Holocene deposits consist of fined-grained overbank deposits and coarse-grained stream channel deposits. These soils are derived from the Santa Ana Mountains to the east and conformably overlie Pleistocene interbedded fine-grained lagoonal and near-shore marine deposits. Pleistocene deposits could not be differentiated from Holocene deposits in Phase I RI soil borings. Pleistocene deposits unconformably overlie semiconsolidated marine sandstones, siltstones, and conglomerates of late

Miocene to late Pliocene, which are considered to be bedrock in the area. A review of boring logs from Phase I RI indicated that the geology in the area of Site 14 consists mainly of silt and clay with lenses of sand.

Hydrogeology

MCAS El Toro lies within the Irvine Groundwater Basin, which is a subbasin of the Los Angeles groundwater basin. Regional aquifers in the Irvine Subbasin tend to be composed of discontinuous lenses of clayey and silty sands and fine-grained gravels contained within a complex assemblage of sandy clays and sandy silts. Three general aquifer systems have been identified near the Station: a shallow and perched system, a principal aquifer zone, and a lower hydrogeologic system existing in bedrock (Jacobs Engineering 1993a).

The Phase I RI results indicate that the shallow, perched zone is not present at Site 14. The principal aquifer is present beneath Site 14 at a depth of approximately 125 feet below ground surface. The regional groundwater flow direction is to the northwest. The local hydraulic gradient has been influenced strongly by the pumping of irrigation wells located west of MCAS El Toro.

Removal Action

In meetings with the Base Realignment and Closure (BRAC) Cleanup Team during June 1995, Site 14 was designated as a Removal Action site. This designation occurred because the nature and extent of contaminants is known and criteria of a Non-Time-Critical Removal Action were satisfied (Section 5 of the Work Plan). An Engineering Evaluation/Cost Analysis, Action Memorandum and community relations are being prepared for this Removal Action.

References

Jacobs Engineering. *See* Jacobs Engineering Group, Inc.

Jacobs Engineering Group, Inc. 1993a. *Installation Restoration Program, Phase I Remedial Investigation Draft Technical Memorandum.* Marine Corps Air Station El Toro, California.

———. 1993b. *Installation Restoration Program, Phase II Remedial Investigation/Feasibility Study, Draft Work Plan.* Marine Corps Air Station El Toro, California.

———. 1994a. *Groundwater Quality Data Report.* Marine Corps Air Station El Toro, California.

———. 1994b. Interviews with active and retired personnel from Marine Corps Air Station El Toro, California.

LUFT. *See* State of California Leaking Underground Fuel Tank Task Force.

SAIC. *See* Science Applications International Corporation.

Science Applications International Corporation. 1993. *Final Report Aerial Photograph Assessment, Marine Corps Air Station El Toro, El Toro, California.* Science Applications International Corporation.

State of California Leaking Underground Fuel Tank Task Force. 1989. *Leaking Underground Fuel Tank Field Manual: Guidelines for Site Assessment, Cleanup, and Underground Storage Tank Closure.*

United States Environmental Protection Agency. 1993. *Guidance for Planning for Data Collection in Support of Environmental Decision Making Using the Data Quality Objectives Process.*

U.S. EPA. *See* United States Environmental Protection Agency.

WORK PLAN APPENDIX O

DATA QUALITY OBJECTIVES
OPERABLE UNIT 3 –
SITE 15 – SUSPENDED FUEL TANKS

SUMMARY

STEP 1 STATE THE PROBLEM

Two 500-gallon elevated diesel fuel tanks were located at Site 15 from 1979 through mid-1984. Diesel fuel leaked onto the soil from the tank fueling hoses and nozzles. These past activities have contaminated soil at this site.

Available information suggests that the contaminated soil may be limited to the shallow soil interval at depths of less than 10 feet below ground surface. The human health and ecological risks associated with the impacted soil will be estimated so that a No Further Investigation or the appropriate remedial alternative can be recommended.

STEP 2 IDENTIFY THE DECISION

The Phase II Remedial Investigation/Feasibility Study decisions to be considered at Site 15 are as follows: Do chemicals of potential concern in the shallow soil at Site 15 present an unacceptable risk to human health and the environment? Are the chemicals of potential concern present in the subsurface soil (greater than 10 feet below ground surface), and if so, do they present an unacceptable risk to groundwater? The possible decision outcomes are recommendations for No Further Response Action Planned, Early Action or Long-Term Action.

STEP 3 IDENTIFY THE INPUTS AFFECTING THE DECISION

Inputs necessary to make these decisions include a list of chemicals of potential concern; the extent of impacted media; background (ambient) concentrations of metals, herbicides, and pesticides; and the action levels for protection of human health and the environment.

STEP 4 DEFINE THE BOUNDARIES OF THE STUDY

The study is limited to the geographic area of Site 15, which comprises two subareas: 1) the Suspended Fuel Tanks (approximately 2,360 $feet^2$), which includes the area beneath the former fuel tanks; and 2) the solid waste management unit/area of concern 273 and the associated drainage ditch, which is located northwest of Building 31 approximately 10,880 $feet^2$). It was added to Site 15 for the Phase II Remedial Investigation/Feasibility Study to investigate these areas.

STEP 5 DEVELOP A DECISION RULE

Action levels developed for decision-making purposes are a cumulative excess cancer risk of 10^{-6} in humans and a hazard index of 1.0 for chronic systemic toxicity in humans. Based on these risk levels, decision rules have been formulated to protect human health and the environment in residential, recreational, and industrial land use scenarios.

STEP 6 SPECIFY LIMITS ON UNCERTAINTY

The number of samples necessary to estimate different levels of risk were calculated using the confidence level of 95 percent and power level of 80 percent limits specified for this project. The preliminary cancer and noncancer risk values were compared to the risk

levels, and the appropriate number of samples necessary to estimate risk were selected for each unit.

STEP 7 OPTIMIZE THE DESIGN

Shallow soil samples will be collected and analyzed at 0, 5, and 10 feet below ground surface at six locations in the area of solid waste management unit/area of concern 273 and the associated drainage ditch.

ACRONYMS/ABBREVIATIONS

AOC	area of concern
ARAR	applicable or relevant and appropriate requirement
BCT	BRAC Cleanup Team
bgs	below ground surface
BRAC	Base Realignment and Closure
COPC	chemical of potential concern
CRDL	contract-required detection limit
DQO	data quality objective
EE/CA	Engineering Evaluation/Cost Analysis
FS	Feasibility Study
FSP	Field Sampling Plan
IDL	instrument detection limit
LUFT	(California) Leaking Underground Fuel Tank (Field Manual)
MCAS	Marine Corps Air Station
MCL	maximum contaminant level
MDL	method detection limit
µg/kg	micrograms per kilogram
µg/L	micrograms per liter
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
ND	nondetect
NEESA	Naval Energy and Environmental Support Activity
NFESC	Naval Facilities Engineering Service Center
NFI	No Further Investigation
PAH	polynuclear aromatic hydrocarbons
ppm	parts per million
PRG	(U.S. EPA Region IX) Preliminary Remediation Goal
RCRA	Resource Conservation and Recovery Act
RFA	RCRA Facility Assessment
RI	Remedial Investigation

ACRONYMS/ABBREVIATIONS (continued)

RI/FS	Remedial Investigation/Feasibility Study
SAIC	Science Applications International Corporation
SVOC	semivolatile organic compound
SWMU	solid waste management unit
TAL	target analyte list
TDS	total dissolved solid
TFH	total fuel hydrocarbons
TPH	total petroleum hydrocarbons
TRPH	total recoverable petroleum hydrocarbons
U.S. EPA	United States Environmental Protection Agency
VOC	volatile organic compound

Appendix O

SITE 15 – SUSPENDED FUEL TANKS

The United States Environmental Protection Agency (U.S. EPA) developed the data quality objectives (DQO) process as a tool for project managers to determine the type, quantity, and quality of data needed to make decisions. Data produced by sampling and monitoring activities are used extensively in problem definition, rule-making, and enforcement decisions. These activities are supported through implementation of the mandatory U.S. EPA Quality System, which requires all organizations to develop and operate management processes and structures for assuring that the data collected are of the necessary and expected quality for their desired use (U.S. EPA 1993).

The U.S. EPA DQO process consists of the following seven steps.

1. **State the problem:** Describe the problem at the site as it is currently understood. The problem statement includes a site conceptual model and an organization and review of all relevant data.
2. **Identify the decision:** Determine an if-then statement that will define what the investigation will seek to determine and what actions will be taken based on the possible outcomes of the investigation.
3. **Identify inputs into the decision:** Specify the analytes or parameters to be measured and used.
4. **Define the study boundary:** Delineate the study boundary from information obtained from Step 1.
5. **Develop a decision rule:** Restate the decision detailing the if-then statement in specific terms.
6. **Specify acceptable limits on decision errors:** Specify how the data will be treated statistically and what the acceptable limits of uncertainty are.
7. **Optimize the design:** Design the field investigation, giving adequate consideration to the results of Steps 5 and 6. This step is described in more detail in the Field Sampling Plan (FSP).

The following sections describe the DQO process for Site 15 – Suspended Fuel Tanks.

STEP 1 – STATE THE PROBLEM

At Site 15, two 500-gallon elevated diesel fuel tanks were located at the suspended fuel tanks from 1979 through mid-1984. Diesel fuel leaked onto the soil from the tanks fueling hoses and nozzles. These past activities have impacted soil at this site.

Available information suggests that the impacted soil may be limited to the shallow soil interval at depths of less than 10 feet below ground surface. The human health and ecological risks associated with the contaminated soil will be estimated so that a No Further Investigation (NFI) or Early Action may be recommended.

Site Description

Site 15 is an unpaved, fenced enclosure located in the western edge portion of the Marine Corps Air Station (MCAS) El Toro north of Building 31 West Marine Way (Figure O-1). The site is relatively flat, and lies at an elevation of about 260 feet mean sea level. Site boundaries for MCAS El Toro Phase I Remedial Investigation (RI) were determined by consensus between the Navy and regulatory agencies prior to initiation of the Phase I RI. Areas of concern were generally grouped together into sites based on common historical activities, aerial photograph review, and their respective locations to each other. For the Phase I RI, Site 15 consisted of two areas where stained soils were evident beneath two former elevated fuel tanks.

Two 500-gallon elevated diesel fuel tanks were located at Site 15 from 1979 through mid-1984. An estimated 500 gallons of diesel fuel leaked onto the soil from the tank fueling hoses and nozzles. The tanks were removed in 1984. Although staining was apparently visible in the past, no evidence of staining was visible at the time of the Phase I RI (Jacobs Engineering 1993a).

Previous Investigations

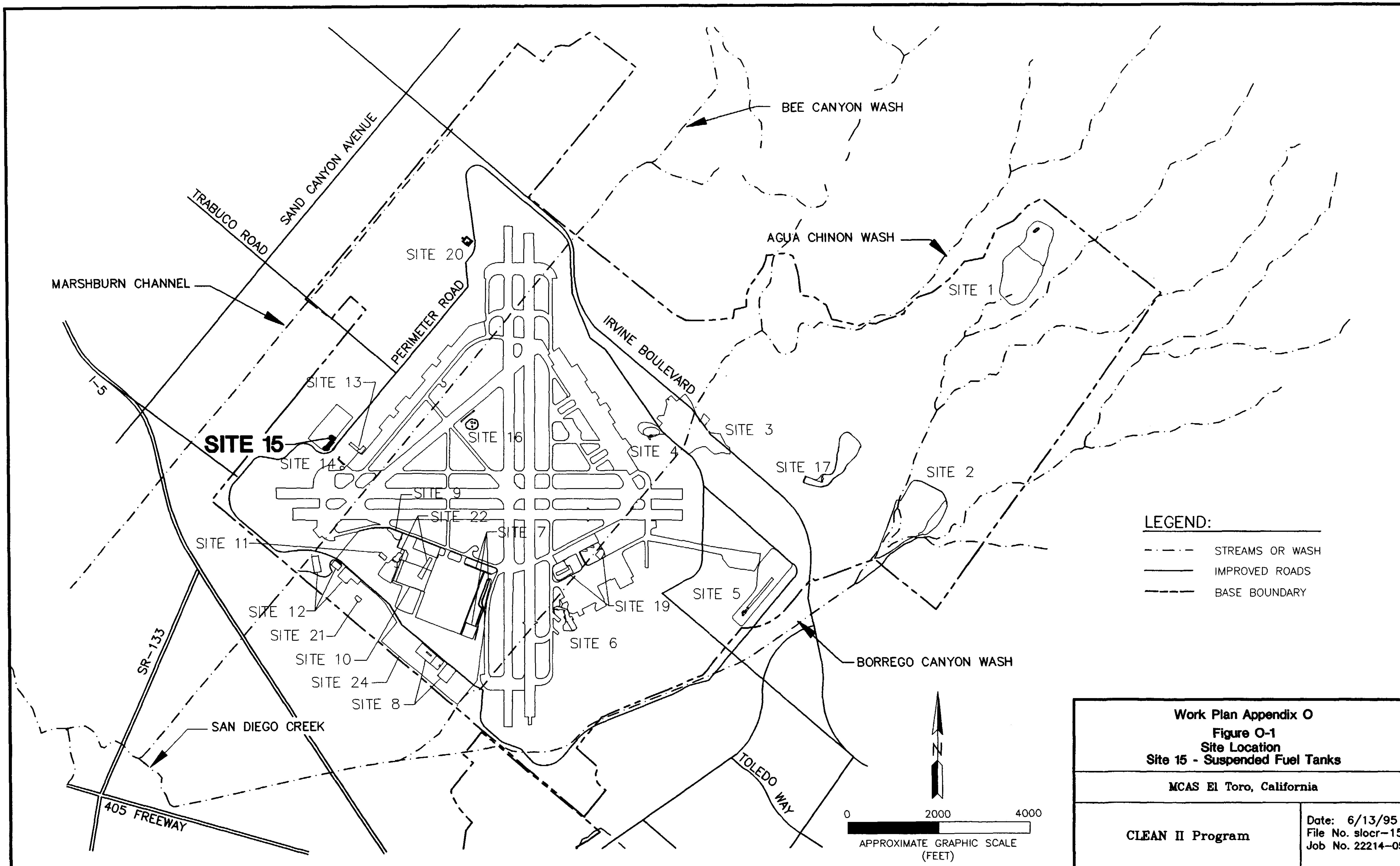
Several investigations have been conducted in the area of Site 15: these are the Resource Conservation and Recovery Act (RCRA) Facilities Assessment (RFA), the Phase I RI, aerial photograph surveys, and employee interviews. The sections below provide a summary of these investigations.

RCRA FACILITIES ASSESSMENT

The RFA identified solid waste management units (SWMUs)/areas of concern (AOCs) 272 and 273 near Site 15 boundaries. The site of a former concrete pad wash area located adjacent to Building 31 was investigated as SWMU/AOC 273. No cracks or significant stains were observed on the concrete surface. The concrete pad abuts Building 31 to the southeast. The pad is sloped to the southwest and runoff from the pad has eroded a drainage path to the southwest. The drainage path originates at the west corner of the pad and leads southwest to the edge of the storage yard. During the investigation:

- three borings were advanced in this area;
- soil samples collected at 2 and 5 feet below ground surface (bgs); and
- soil samples were analyzed for total recoverable petroleum hydrocarbons (TRPH) and volatile organic compounds (VOCs).

SWMU/AOC 272 is a hazardous waste storage area and is located about 40 feet northwest of Building 31. SWMU/AOC 272 consists of a concrete pad with a 6-inch concrete beam. There was no staining observed on the concrete pad or the ground surface around the pad during the RFA. During the investigation:



Work Plan Appendix O

Figure O-1
Site Location
Site 15 - Suspended Fuel Tanks

MCAS El Toro, California

CLEAN II Program

Date: 6/13/95
File No. slocr-15
Job No. 22214-059

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- one deep boring was advanced to a depth of 60 feet;
- samples were collected at 10, 20, 30, 40, 50, and 60 feet; and
- soil samples were analyzed for target analyte list (TAL) metals, TRPH, total fuel hydrocarbons (TFH)-diesel and -gasoline, and VOCs.

The ranges of analyte concentrations detected during the RFA are summarized below (RCRA Facility Assessment Report, Volume I, Appendix A, Jacobs Engineering 1993b).

Shallow Soil (SWMU/AOC 273)

VOCs: acetone (29 to 41 micrograms per kilogram [µg/kg] [H3 at 2 feet]), methylene chloride (5BJ to 7BJ µg/kg [H3 at 2 feet]);

No TRPH constituents were detected any of the soil samples, and although, small concentrations of VOCs were detected in all soil samples, none were detected at levels above their respective U.S. EPA Region IX Preliminary Remediation Goals (PRGs).

Shallow Soil (SWMU/AOC 272)

- metals: aluminum (3,640 to 26,300 µg/kg [A1 at 10 feet]);
- VOCs: 2-butanone (2BJ to 4J µg/kg [A1 at 20 feet]), acetone (12B to 45B µg/kg [A1 at 40 feet]), methylene chloride (5BJ to 100B µg/kg [A1 at 20 feet]); and
- fuel and petroleum hydrocarbons: TRPH (nondetect [ND] to 79 milligrams per kilogram [mg/kg] [A1 at 20 feet]), TFH-gasoline (ND to 0.535 mg/kg [A1 at 10 feet]).

TRPH (ND) = Not detected above the method detection limit (MDL) for U.S. EPA Method 418.1.

TFH (ND) = Not detected above the MDL for U.S. EPA Method 8015M.

J = Indicates an estimated value for qualitative use only (organic parameters).

B = Indicates reported value is less than the contract-required detection limit (CRDL), but greater than the or equal to the instrument detection limit (IDL) (inorganic parameters).

Small concentrations of VOCs, TFH, and TRPH were detected in samples to a depth of 30 feet, however, none of these constituents were detected above the PRGs for these chemicals of potential concern (COPCs) (Jacobs Engineering 1993b).

PHASE I REMEDIAL INVESTIGATION

For the Phase I RI, subareas within sites were designated as strata. Due to the fact that some new subareas have been added or subareas have been expanded or diminished for the Phase II RI/Feasibility Study (FS), subareas within sites will be referred to as units for the Phase II RI/FS. In this section, discussion is related to Phase I RI sampling and results, and the term strata will be used. Following this section, the term unit will be used.

During the Phase I RI, Site 15 was represented by 1 stratum (Suspended Fuel Tanks) (Figure O-2). The following site-specific activities were conducted:

- soil samples were collected at 0 and 2 feet bgs at five locations;
- one deep boring was drilled, sampled, and completed as a monitoring well;
- soil samples were analyzed for TRPH, TFH, VOCs, semivolatile organic compounds (SVOCs), and TAL metals; and
- groundwater samples were analyzed for general chemistry, VOCs, SVOCs, and TAL metals.

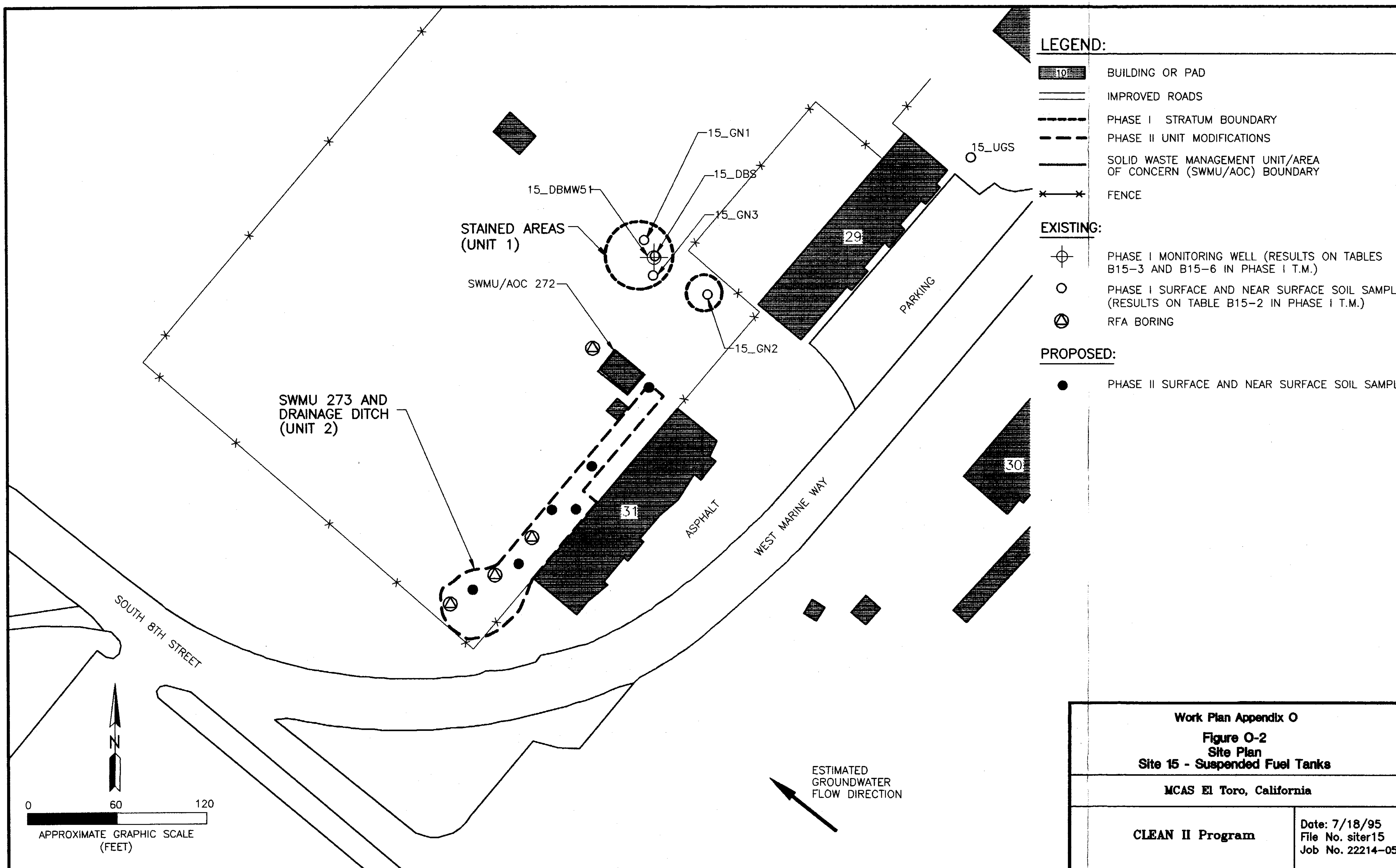
A summary of the ranges of analyte concentrations detected during the Phase I RI (sample identification of the highest concentration is provided), plus recent groundwater monitoring data are presented below. All COPCs that were detected in soil are listed with the exception of specific metals, which are listed only if they exceed PRGs or ecological screening criteria in shallow soil. All COPCs that exceed PRGs or maximum contaminant levels (MCLs) in groundwater are included in this list. If a minimum concentration is recorded with a "less than" symbol, it denotes a concentration below the contract laboratory program detection limit. Sample locations are shown on Figure O-2. A complete listing of all detected chemicals is presented in the Phase I RI Technical Memorandum, Appendix B-15, Tables B15-2 through B15-7, (Jacobs Engineering 1993a), and in the Groundwater Quality Data Report (Jacobs Engineering 1994). TAL metals that were analyzed during the Phase I RI are beryllium, barium, arsenic, antimony, aluminum, cadmium, calcium, cobalt, copper, iron, lead, magnesium, manganese, mercury, nickel, potassium, selenium, silver, sodium, thallium, vanadium, and zinc.

Shallow Soil (less than 10 feet below ground surface)

- metals: 22 of 23 TAL metals;
- VOCs: acetone (< 11 to 87 µg/kg [15_DBS at 0 feet]), methylene chloride (< 1 to 58B µg/kg [15_DBS at 0 feet]), toluene (< 10 to 4J µg/kg [15_GN3 at 2 feet]);
- SVOCs: bis(2-ethylhexyl) phthalate (< 670 to 370J µg/kg [15_GN2 at 2 feet]), benzyl butyl phthalate (< 670 to 1,200 µg/kg [15_GN2 at 2 feet]), chrysene (< 670 to 210J µg/kg [15_UGS at 0 feet]), phenanthrene (< 670 to 5,300J µg/kg [15_DBS at 0 feet]); and
- fuel and petroleum hydrocarbons: TFH-diesel (< 13.5 to 8,530 mg/kg [15_DBS at 0 feet]), TFH-gasoline (< 0.05 to 21.1 mg/kg [15_DBS at 0 feet]), TRPH (< 20 to 23,034 mg/kg [15_DBS at 0 feet]).

Subsurface Soil (greater than 10 feet below ground surface)

- metals: 20 of 23 TAL metals;



Work Plan Appendix O **Figure O-2** **Site Plan** **Site 15 - Suspended Fuel Tanks**	
MCAS El Toro, California	
CLEAN II Program	Date: 7/18/95 File No. siter15 Job No. 22214-059

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- VOCs: 2- butanone (< 12 to 6J µg/kg [15_DBMW51 at 10 feet), acetone (< 11 to 10J µg/kg [15_DBMW51 at 100 feet]), carbon disulfide (< 11 to 14 µg/kg [15_DBMW51 at 10 feet]), toluene (< 11 to 4J µg/kg [15_DBMW51 at 5 feet), xylenes (< 11 to 3J µg/kg [15_DBMW51 at 5 feet]); and
- fuel and petroleum hydrocarbons: TFH-diesel (< 13.2 to 2,540 mg/kg [15_DBMW51 at 5 feet]), TFH-gasoline (< 0.053 to 4.44 mg/kg [15_DBMW51 at 5 feet), TRPH (< 20 to 1,377 mg/kg [15_DBMW51 at 5 feet]).

Groundwater (15_DBMW51 on-site)

- general chemistry: chloride (1,210 to 1,570 milligrams per liter [mg/L]), nitrate/nitrite (46.9 to 63.4 mg/L), sulfate (1,350 to 1470 mg/L), total dissolved solids (TDS) (5,260 to 6,600 mg/L);
- metals: antimony (40.7B to 54.6B micrograms per liter [µg/L]), manganese (184 to 811µg/L), selenium (93.5 to 117 µg/L), and 12 other TAL metals; and
- VOCs: benzene (63 to 150 µg/L), methyl chloride (< 2 to 1J µg/L), xylenes (19 to 36 µg/L).

J = Indicates an estimated value for qualitative use only (organic parameters).

B = Indicates reported value is less than the contract-required detection limit (CRDL), but greater than the or equal to the instrument detection limit (IDL) (inorganic parameters).

The concentration of analytes detected in shallow soil were compared to PRGs of the COPCs and ecological screening criteria. The results of this investigation indicate that no COPCs detected in the shallow soil exceed PRGs.

Petroleum hydrocarbons detected in shallow soil were compared to California Leaking Underground Fuel Tank (LUFT) Field Manual guidelines to evaluate their potential to migrate to the groundwater (LUFT 1989). Based on LUFT guidelines, petroleum hydrocarbons in the shallow soil at Site 15 do not appear to pose a threat to groundwater.

Groundwater samples were collected from the groundwater monitoring well (15_DBMW51) constructed on Site 15. The results were compared to applicable human health PRGs and MCLs:

- benzene, antimony, manganese, and nitrate, and selenium, exceed primary MCLs; and chloride, manganese, sulfate; and
- TDS exceed secondary MCLs.

U.S. EPA AERIAL PHOTOGRAPH SURVEY

The results of the U.S. EPA Aerial Photo Survey performed for MCAS El Toro indicated that no features related to Site 15 were identified. In the 1991 photograph, the area of Site 15 was seen to be an open storage area. Liquid and stain flows were observed to emanate approximately from the area of the former fuel stains (Jacobs Engineering 1993a).

SCIENCE APPLICATIONS INTERNATIONAL CORPORATION AERIAL PHOTOGRAPH SURVEY

The Science Applications International Corporation Survey identified an extensive open storage area west of Buildings 29 and 31 in 1946 photograph. Dark mounded material was evident immediately west of Building 29 and north of Site 15. Because the suspended fuel tanks were not used until approximately 1979, the mounded material cannot be related to Site 15. An open storage area with possible drums was visible on the 1955 photograph west and north of Building 29. In the 1974 photograph, disturbed ground was seen on the northwest sides of Buildings 25, 27, and 29; stains were visible approximately 100 feet southwest of Building 31. No site-related features were identified by the Science Applications International Corporation photo assessment (SAIC 1993).

Geology

The geology of Site 15 consists of Quaternary alluvial and marine deposits (Jacobs Engineering 1993a). Holocene deposits consist of fine-grained overbank deposits and coarse-grained stream channel deposits. These soils are derived from the Santa Ana Mountains to the east and conformably overlie Pleistocene interbedded fine-grained lagoonal and near-shore marine deposits. Pleistocene deposits could not be differentiated from Holocene deposits in Phase I RI soil borings. Pleistocene deposits unconformably overlie semiconsolidated marine sandstones, siltstones, and conglomerates of late Miocene to late Pliocene, which are considered to be bedrock in the area. Based on a review of boring logs subsurface lithology at Site 15 consists mainly of sand with varying amounts of silt and clay (Jacobs Engineering 1993a).

Hydrogeology

MCAS El Toro lies within the Irvine Groundwater Basin, which is a subbasin of the Los Angeles groundwater basin. Regional aquifers in the Irvine Subbasin tend to be composed of discontinuous lenses of clayey and silty sands and fine-grained gravels contained within a complex assemblage of sandy clays and sandy silts. Three general aquifer systems have been identified near the Station: a shallow and perched system, a principal aquifer zone, and a lower hydrogeologic system existing in bedrock (Jacobs Engineering 1993a).

The Phase I RI results indicate that the shallow, perched zone is not present at Site 15. The principal aquifer is present beneath Site 15 at a depth of 125 feet bgs. The regional groundwater flow direction is generally to the northwest. The local hydraulic gradient has been influenced strongly by the pumping of irrigation wells located west of MCAS El Toro.

Conceptual Site Model

In the process of developing a conceptual site model, release mechanisms and potential sources of contamination were considered and evaluated to determine their applicability to the site. Also considered in the development of the conceptual site model were potential receptors and contaminant pathways to potential receptors. Figure O-3 illustrates the conceptual site model developed for the site. Figure O-4 depicts the potential exposure routes and pathways for human and ecological receptors.

The primary release mechanism is contaminants released to shallow soil from disposal activities at this site. Eventually under gravity, contaminants present in shallow soil may move downward with soil moisture (in dissolved phase) or in a liquid phase. The depth of groundwater is estimated to be about 125 feet bgs.

The secondary source of contaminants is the surrounding soil impacted by disposal activities. One secondary release mechanism is the dust brought into suspension in the air by wind. The fine particles of dust may contain all potential contaminants. Storm water runoff may form another secondary release mechanism. Storm water carries contaminants in dissolved forms, colloidal forms, or associated with suspended soil particles.

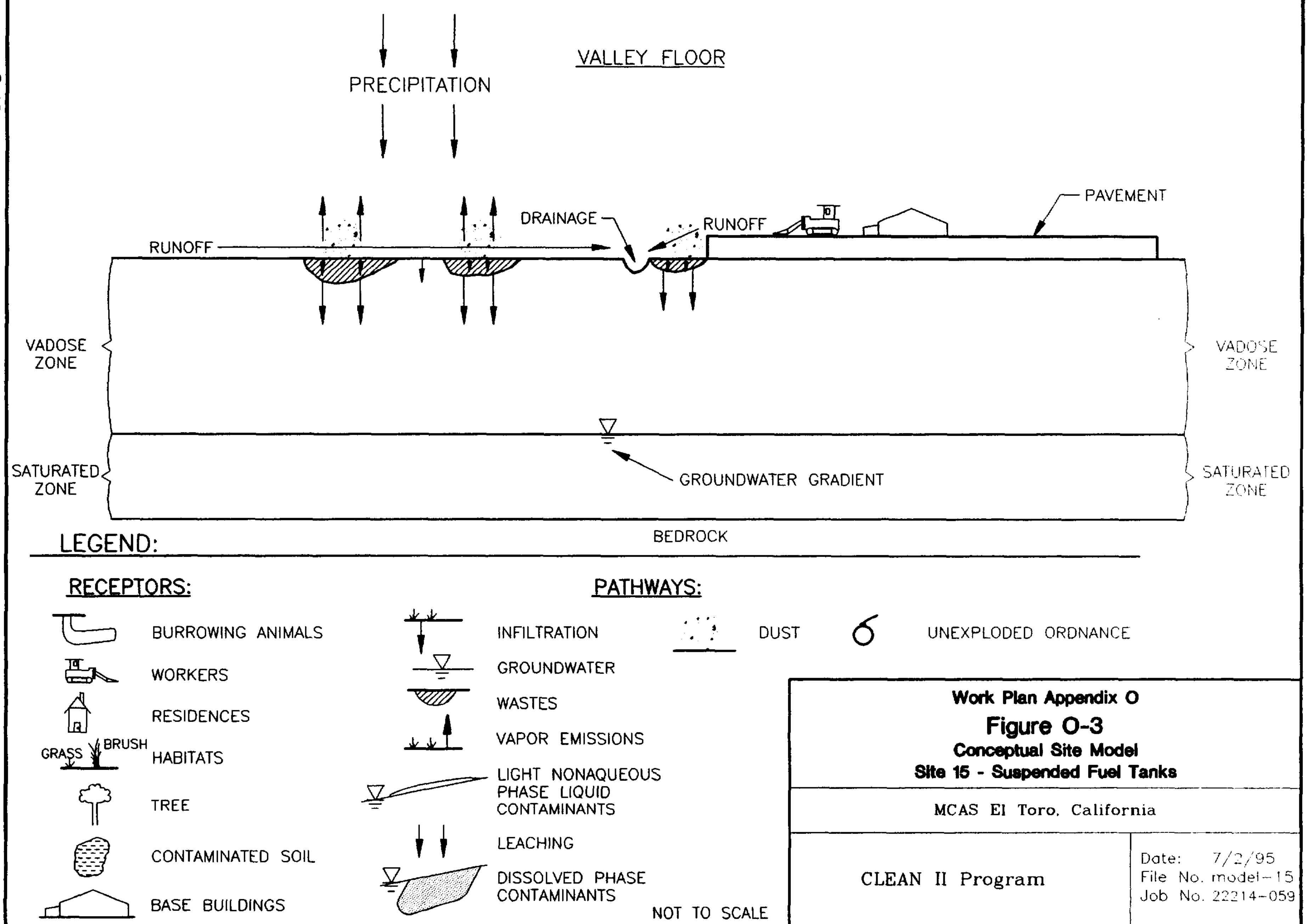
The potential pathways are air, groundwater, and surface water. Airborne contaminants are transported through fugitive dust and volatilization. The transport through air is affected by wind speed and direction, type of contaminant, and weather condition. Typically winds at MCAS El Toro are from west/southwest at less than 10 knots. Transportation of airborne contaminants through volatilization is expected to be unimportant at this site. Surface water transport is affected by the amount of rainfall, type of contaminant, surface soil properties, and the topography of the area. The mean annual rainfall at MCAS El Toro is about 14.0 inches, most of it occurs from November through April.

Current and/or potential receptors of chemicals at this site via inhalation are workers and visitors involved in disposal activities. Direct contact with surface and subsurface soils is currently possible via dermal or ingestion exposures of workers. Infiltration of contaminated water through the vadose zone into groundwater is possible because subsurface soil is mainly sands, with some silts and clays. However, current exposure of workers is unlikely via ingestion of groundwater at this site.

Terrestrial wildlife could be exposed to chemicals in on-site surface soil, and dust and vapors through ingestion, dermal absorption or inhalation. Terrestrial plants could also be exposed through root absorption of chemicals in surface soil or deposition of dusts. No special-status species were observed at this site, and the immediate area provides marginal habitat for wildlife species.

Statement of Phase II RI/FS Problem

Site 15 is an unpaved, fenced enclosure located in the western edge portion of MCAS El Toro north of Building 31, West Marine Way. Two 500-gallon elevated diesel fuel tanks were located at Site 15 and fuel leaked from the tank fueling hoses and nozzles onto the ground surface. The problems associated with this site are the following:



Work Plan Appendix O

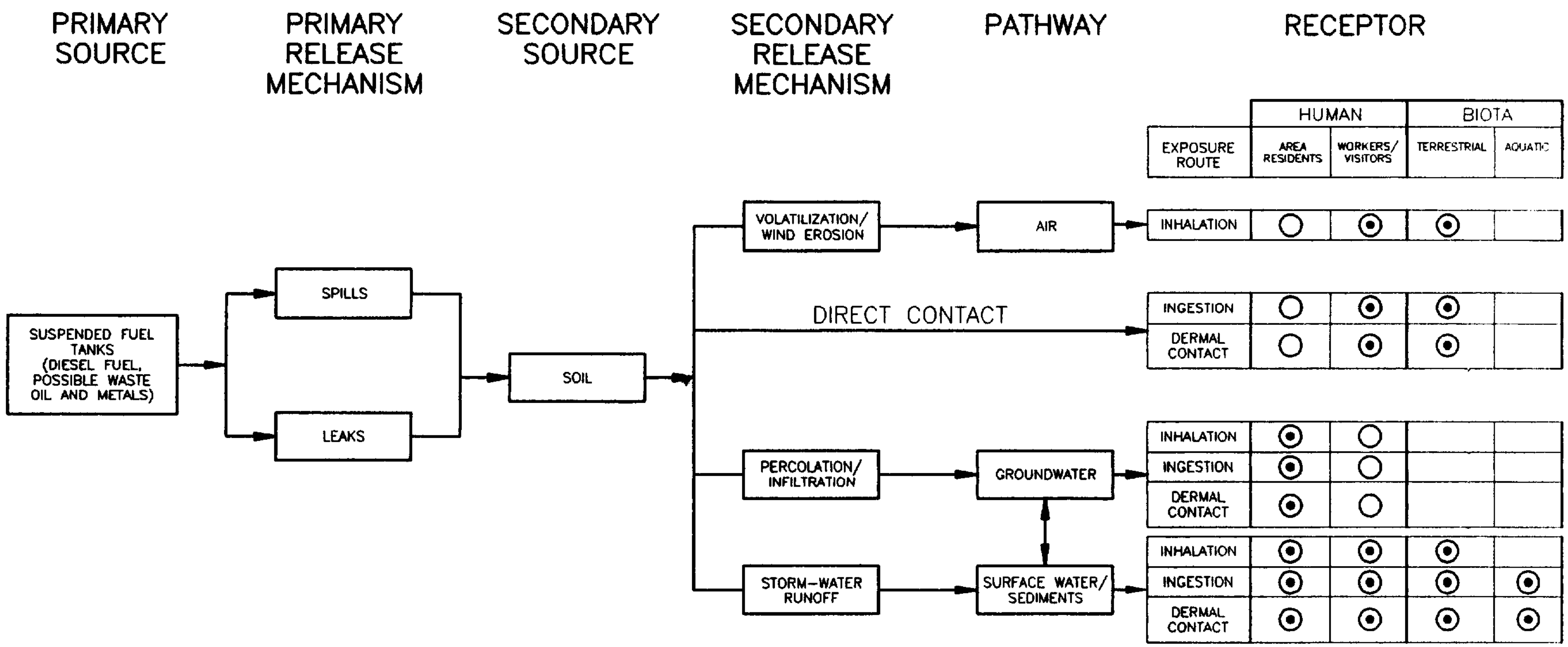
Figure O-3

Conceptual Site Model
Site 15 - Suspended Fuel Tanks

MCAS El Toro, California

CLEAN II Program

Date: 7/2/95
File No. model-15
Job No. 22214-059



LEGEND:

● CURRENT POTENTIAL RECEPTOR

○ FUTURE POTENTIAL RECEPTOR

Work Plan Appendix O

Figure O-4

Exposure Routes and Receptors
Site 15 - Suspended Fuel Tanks

MCAS El Toro, California

CLEAN II Program

Date: 6/28/95
File No. mod15
Job No. 22214-059

- shallow soil is impacted with VOCs, SVOCs, and petroleum hydrocarbons;
- the area added to Site 15 for the Phase II RI/FS has not been sampled and needs to be assessed;
- based on LUFT guidelines (LUFT 1989), petroleum hydrocarbons detected in shallow soil at Site 15 do not pose a threat to groundwater; and
- more data are necessary to calculate a cumulative excess cancer risk and hazard index for the site.

STEP 2 – IDENTIFY THE DECISION

This step describes the decisions that will be considered during the DQO process for Site 15. For each decision, the alternative outcomes are stated. The Sampling Decision Process is illustrated on Figure O-5. For Site 15, the following decisions will be considered:

1. Do COPCs in shallow soil (less than 10 feet bgs) in the unit exceed established background concentrations and PRGs, and/or do they present an unacceptable risk to human health or the environment?

   If yes, proceed to the next decision.

   If uncertain, collect additional soil samples to determine risk.

   If no, recommend the unit for NFI.

2. Has the extent of impacted soil been defined in the shallow soil?

   If yes, evaluate a response action.

   If no, conduct soil sampling to define extent.

3. Does the extent of impacted shallow soil extend into the subsurface (greater than 10 feet bgs)?

   If yes, conduct soil sampling to define vertical extent of impacted soil, and if necessary, evaluate potential impacts to groundwater beneath the site.

   If no, evaluate a response action.

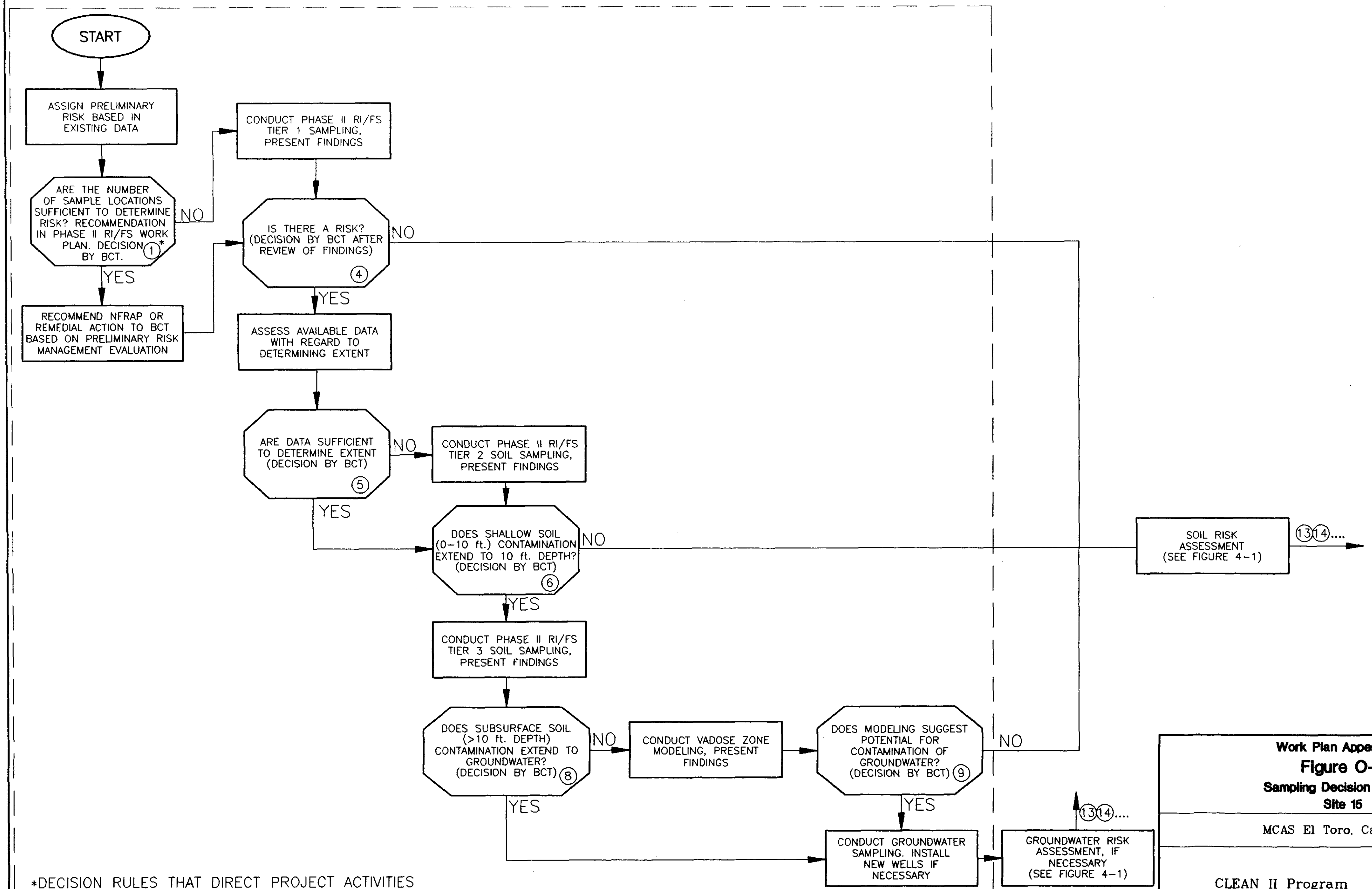
4. Do the media being evaluated for a response action qualify for Early Action?

   If yes, recommend unit for an Engineering Evaluation/Cost Analysis (EE/CA).

   If no, recommend unit for a remedial response as part of the RI/FS process.

STEP 3 – IDENTIFY THE INPUT AFFECTING THE DECISION

Step 2 defined the decisions addressing possible actions at the site. Step 3 will identify the inputs that are required to assess the actions as discussed below:



Work Plan Appendix O

Figure O-5

Sampling Decision Process

Site 15

MCAS El Toro, California

CLEAN II Program

Date: 3/11/95
File No. Logicr15
Job No. 22214-059

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Inputs for No Further Investigation

Input information required to support a NFI recommendation will also be used to support decisions for Early Action and Long-Term Action. These inputs are as follows:

- list of COPCs;
- definition of the extent of impacted soil;
- background concentrations for metals, pesticides, and herbicides;
- determination of risk for the unit; and
- action levels for the protection of human health and the environment.

Inputs for Early Action

In addition to the inputs required for a NFI recommendation, input information required to support a Early Action recommendation will include the following:

- applicable or relevant and appropriate requirements (ARARs);
- identification of cleanup standards;
- identification of cleanup technology applicability/limitations that are not extensive operation and maintenance activities; and
- site/unit cleanup in less than 5 years.

Inputs for Long-Term Action

In addition to the inputs required for a NFI recommendation, input information required to support a Long-Term Action recommendation may include the following:

- ARARs;
- identification of cleanup standards;
- identification of cleanup technology applicability/limitations;
- pilot testing of remedial alternatives; and
- site/unit cleanup in more than 5 years.

Descriptions of Inputs

The following subsections discuss the inputs required to assess possible response actions.

CHEMICALS OF POTENTIAL CONCERN

The COPCs for Site 15 include all chemicals detected in the Phase I RI for each medium and stratum. COPCs for Site 15 are listed (by media and chemical class) below.

Shallow Soil (less than 10 feet below ground surface)

- metals: aluminum, antimony, arsenic, barium, beryllium, cadmium, chromium*, cobalt, copper, lead, manganese, mercury, nickel, selenium, silver, thallium, vanadium, zinc;
- VOCs: acetone, methylene chloride, toluene;
- SVOCs: bis(2-ethylhexyl) phthalate, benzyl butyl phthalate, chrysene, phenanthrene; and
- fuel and fuel hydrocarbons: TFH-diesel and -gasoline, TRPH.

Subsurface Soil (greater than 10 feet below ground surface)

- metals: aluminum, antimony, arsenic, barium, beryllium, cadmium, chromium*, cobalt, copper, lead, manganese, mercury, nickel, selenium, silver, thallium, vanadium, zinc;
- VOCs: 2- butanone, acetone, carbon disulfide, toluene, xylenes;
- SVOCs: bis(2-ethylhexyl) phthalate, benzyl butyl phthalate, chrysene, phenanthrene; and
- fuel and petroleum hydrocarbons: TFH-diesel and -gasoline, TRPH.

* = Soil samples will be field screened for total chromium, if the sample result indicates a concentration of chromium of 50 parts per million (ppm) or greater, then the soil sample will be further analyzed for hexavalent chromium by a fixed-base laboratory under Naval Facilities Engineering Service Center (NFESC; formerly known as NEESA) Level D protocol.

Groundwater – On-Site

- metals: antimony, arsenic, barium, cadmium, lead, manganese, nickel, selenium, vanadium, zinc;
- VOCs: 2-hexanone, benzene, chloromethane, xylenes;
- SVOCs: phenol; and
- fuel and petroleum hydrocarbons: TFH-diesel and -gasoline.

THE NATURE AND EXTENT OF CONTAMINATION

Phase II RI/FS sample locations, depths, and chemical analyses have been designed to assess the risk associated with the site. Additional sampling will be conducted if it is necessary to further define the extent of impacted shallow soil, subsurface soil, or groundwater.

BACKGROUND CONCENTRATIONS

The background concentrations for metals, herbicides, and pesticides are presented in Section 4 of the Phase II RI/FS Work Plan.

DETERMINATION OF RISK

A determination of the human health risk associated with each site is based on a baseline or streamline risk assessment. Baseline risk assessments are performed on RI/FS sites. The objective of a baseline risk assessment is to estimate the risks associated with the no action alternative and thereby provide decision makers information useful in identifying the most appropriate remedial action alternative. The risk estimates produced also serve as a benchmark to which reductions in risk achieved by remedial actions may be compared. Streamlined risk assessments are performed on removal action sites to support the removal action.

In addition to the human health risk assessment conducted for a site, an ecological risk assessment may also be performed. The ecological risk assessment will evaluate current and potential risks to the environment posed by the chemical releases that have occurred at the sites.

IDENTIFICATION OF CLEANUP LEVELS

Cleanup levels will be based on ARARs, background concentrations, and risk levels that will be determined for the site.

CLEANUP TECHNOLOGY EFFECTIVENESS, IMPLEMENTABILITY, AND COSTS

Once cleanup levels have been established, the most appropriate and cost-effective approach will be identified to remediate the site, if necessary.

STEP 4 – DEFINE THE BOUNDARIES OF THE STUDY

This step defines the spatial and temporal boundaries of the problem and any practical constraints that may interfere with the study.

- Unit 1 – Suspended Fuel Tanks (approximately 2,360 feet^2 the area beneath the former fuel tanks. This unit has the same boundaries as Phase I RI Site 15 Stratum 1).
- Unit 2 – SWMU/AOC 273 and the associated drainage ditch (approximately 10,880 feet^2 the area adjacent to the northwest of Building 31. Unit 2 was created for the Phase II RI/FS to investigate these areas).

Specification of temporal boundaries for the field sampling activities is unnecessary. Shallow and deeper subsurface soil conditions are not considered to be significantly different from conditions during the Phase I RI sampling or throughout the period since spillage or unregulated waste disposal activities occurred on the site.

STEP 5 – DEVELOP A DECISION RULE

Decision rules are required to explicitly state the types of inputs and logical basis for choosing among alternative actions during the Phase II RI/FS. A list of all decision rules for the project are included in Section 4 of the Work Plan. Specific decision rules that will be followed to determine an action are presented here. These decision rules conform to the numbering sequence presented in Section 4 of the Work Plan.

2. If Phase I data are sufficient to assess a response action to reduce risk associated with site units that exceed media action levels or background concentrations, then the cleanup levels and appropriate response action (Early Action or Long-Term Action) will be determined.

3. If Phase I data are not sufficient to assess whether risks are present based on the minimum number of samples, then Tier 1 sampling of the Phase II RI/FS will be completed to supplement the Phase I analytical results so the minimum number of samples is satisfied to assess whether action levels or background concentrations are exceeded in site units.

4. If Phase I data and Tier I data for the Phase II RI/FS indicate that no solid wastes are exposed and respective action levels or background concentrations for the various media of a site unit are not exceeded, then NFI will be recommended.

5. If Phase I data or Tier 1 data of the Phase II RI/FS combined with Phase I data exceed PRGs, action levels, or background concentrations for the various media, then Tier 2 of the Phase II RI/FS sampling and analyses will be conducted to define horizontal and vertical extent, provided additional sampling costs are not more than a potential response action.

6. If PRGs, action levels, or background concentrations for shallow soil are exceeded, and if COPCs detected in the soil extend to 10 feet bgs, then soil below 10 feet bgs (subsurface soil) will be investigated to assess the horizontal and vertical extent of the COPCs.

7. If during the investigation of COPCs in subsurface soil, two consecutive soil sample analyses (at a minimum 5-foot-depth separation) demonstrate that COPCs are not detected, then the vertical extent of soil contamination will be established and investigation of subsurface soil will be halted at that location. The horizontal extent will be established when COPCs are not detected in vertical samples taken at three locations around the sample that exceeds the action levels.

   The lowest detection limit available will be used to define the base of a contaminant plume. COPC detection or quantitation limits that will be compared to establish the base of the contaminant plume include the following:

   - CRDL,
   - contract-required quantitation limit,
   - sample quantitation limit,
   - estimated quantitation limit,
   - practical quantitation limit,

- MDL, and
- IDL.

8. If during the investigation of COPCs in subsurface soil, it is determined by actual sampling that COPCs extend to the water table, groundwater beneath the site will be investigated for the presence of the COPCs.
9. If COPCs are identified in subsurface soil below 10 feet bgs, above background and action levels, but do not extend to the water table, then vadose zone computer modeling will be used to evaluate the potential for the COPCs to impact groundwater.
10. If it is determined that COPCs in subsurface soil have impacted groundwater causing exceedance of action levels, then the vertical and horizontal extent of groundwater exceedance will be evaluated.
13. If action levels or background concentrations are exceeded for the media of a site unit, then the risk assessment will be initiated, based on sample results, acceptable levels of risk, and potential land uses, to assess potential risks to human health and/or the environment.
14. If unacceptable risks are assessed to human health or the environment, then cleanup levels will be evaluated for each media.
15. If cleanup levels in a given medium are exceeded, and if the site meets at least one of the eight criteria for removal action described in 40 *Code of Federal Regulations* 300.415(b)(2), and the scale and complexity of contaminant distribution in the affected medium are such that excess risk can be expediently reduced utilizing readily available technology, then the medium at the site will be recommended for Early Action.
16. If an early removal action is selected, a non-time-critical EE/CA and Action Memorandum will be completed for the removal action.
17. Once the removal action is completed, the site will be evaluated for residual risk. If a residual risk exists, then a Long-Term Action may be required.
18. If cleanup levels for a given medium are exceeded, and if the site does not meet criteria for an Early Action, then the affected medium will be recommended for long-term remedial action as part of the RI/FS process; and an Feasibility Study will be completed, followed by a Record of Decision, Remedial Design, and Remedial Action to clean up the site for closure.

STEP 6 – SPECIFY LIMITS ON UNCERTAINTY

The purpose of Step 6 is to specify the tolerance limits for decision errors, which are used by the decision makers to establish performance goals for the data collection design. The objective of the data collection design is to obtain data that reliably estimate the true nature of environmental conditions at Site 15. This process is presented in Section 4 of the Work Plan and the following presents specific information on Site 15.

Identify the Null Hypothesis and Specify the Decision Errors

The null hypothesis for this site specifies that the concentrations of one or more of the COPCs exceed PRGs or risk-based action levels and present an unacceptable risk at the site.

The alternative hypothesis for this site specifies that the concentrations of one or more of COPCs do not exceed PRGs or risk-based actions levels and represent an acceptable risk at the site.

The false-positive and false-negative decision errors are discussed in Section 4 of the Work Plan.

Decision Error Limits

For the Phase II RI/FS, the allowable probability of making a false-positive decision has been designated as 0.05 (confidence of 95 percent) and an allowable probability of making a false-negative decision error has been designated as 0.20 (power of 80 percent).

Calculating the Number of Samples Necessary to Determine Risk

The number of sample locations necessary to determine the risk at a unit or a site were estimated using the process presented in Section 4 of the Work Plan. The number of additional sample locations needed to assess risk during the Phase II RI/FS is the difference between the total number of sample locations and the number of locations sampled during the Phase I RI (Table O-1).

Sampling Designs for the Operable Unit-3 Sites

Two types of sampling designs will be used to determine the soil conditions at the OU-3 sites. These sampling designs are:

- stratified random sampling (either whole or partial unit areas, with replacement where sample locations are closely spaced or overlap), and
- areal systematic random sampling based on a grid.

A description of these Phase II RI/FS sampling designs is presented in Section 4 of the Work Plan. These sampling designs utilize random positioning to produce an unbiased configuration of sample locations. The advantage of a random, unbiased sampling design is that the tolerance limits for false-positive and false-negative decision errors can be applied to the sample data and risk decisions can be assigned a level of confidence.

STEP 7 – OPTIMIZE THE DESIGN

Historic site activities, previous site investigation results, and regulatory comments were used to formulate the Phase II RI/FS sampling approach. Shallow and deeper subsurface soils will be investigated at this site using a tiered sampling approach. This sampling approach consists of three tiers:

Table O-1
Summary of Phase II RI/FS OU-3 Soil Sampling Strategies

Description	Unit Area	Estimated Risk[a]	Number of Locations/ Samples[b]	Number of Phase I Locations/ Samples	Number of Phase II Locations/ Samples	Tier	Type of Sampling Strategy
Site 15–Suspended Fuel Tanks	Unit 2–10,880 ft^2	UNK	12(36)	0	6(18)[c]	1	Areal Systematic Random

Notes:

[a] These estimated cumulative cancer risk values were developed using Phase I RI data, and COPC-specific risk-based concentrations were developed following completion of Phase I RI activities. Numbers in parentheses are the estimated hazard index values.

[b] Number of samples based on comparison of estimated cancer risk to Table 4-7 in Phase II RI/FS Work Plan, which correlates four cancer-risk categories to the number of samples needed to determine that risk using the project-specific power and confidence limits. For this column, the first number represents sample locations, and the second number (in parentheses) is the number of samples based on an average of three depth intervals per sample location.

[c] These numbers represent the difference between the number of samples required to determine risk and the number of samples collected as part of the Phase I RI, with the following provisions:
Where Phase II RI/FS sample locations were recommended to determine risk, the area covered by this number of locations was based upon the U.S. EPA risk determination standard of a 40- x 40-meter block per sample location. This corresponds to an area of about 206,700 $feet^2$ for 12 sample locations. If the unit area is greater than this size limit, the maximum specified number of samples, less the Phase I RI number of samples, will be collected during the Phase II RI/FS. If the unit area is less than this size limit, the number of sample locations represents a ratio of the unit area versus the 12-sample area (206,700 $feet^2$) times 12 (e.g., Site 19, Unit 3: [Unit 3 area/206,700 $feet^2$]) x 2 locations = 9 locations needed - 3 Phase I locations = 6 new Phase II RI/FS locations required. Use of this ratio rule should maintain the necessary power and confidence limits at units where fewer samples are collected. At units where the ratio rule is applied, the total number of samples (Phase I and Phase II combined) will never be less than six despite the ratio calculation, to be sure that the minimum number of sample locations necessary for a risk assessment is collected. The number of Phase II RI/FS shallow soil boring locations has been based on three samples per location. However, at Site 8 (Unit 3) and Site 12 (Units 1, 2, and 4), four samples per location will be collected.

- The main focus of the Tier 1 sampling plan will be to determine whether the unit is a risk. The Tier 1 sampling approach will consist of collecting shallow soil samples (less than 10 feet bgs) from a specific number of sampling locations within the unit. The number of sampling locations has been proposed such that when the Phase I and II RI/FS data are evaluated together, an assessment of risk can be completed for the unit.
- The Tier 2 sampling approach will also focus on shallow soil; however, the primary objective will be to refine the extent of shallow soil that has been impacted by site activities, by focusing on subareas of the unit where COPCs exceeded PRGs as identified by the Tier 1 sampling and/or Phase I RI/FS results.
- The Tier 3 sampling approach has been designed to estimate the horizontal and vertical extent of impacted subsurface soil (greater than 10 feet bgs). This sampling strategy will only be implemented if Phase I RI/FS soil sample analytical data or Phase II RI/FS Tier 1/Tier 2 soil sample analytical data suggest impacted soil exists at depths greater than 10 feet bgs. Groundwater will be investigated if Phase I or Phase II soil data indicate potential impacts to groundwater are possible.

The tiered sampling approach is detailed in the following sections and in the FSP, Attachment O (BNI 1995). For a list of all soil sampling and analysis at Site 15, see Table O-2.

Tier 1

The Tier 1 of sampling will be collection of shallow samples from each unit within the site as described below. For a list of all soil sampling and analysis at Site 15, see Table O-2.

TIER 1 SOIL SAMPLING

Tier 1 sample locations within the units will be positioned using areal systematic random (grid) or stratified random sampling designs to collect data in support of risk assessment and to characterize additional areas not sampled as part of the Phase I RI (Figure O-2).

Unit 1: Suspended Fuel Tanks

Unit 1 is presently being addressed as a Early Action through the Non-Time-Critical Removal Action process. An EE/CA has been prepared for this unit.

Unit 2: SWMU/AOC 273 and Associated Drainage Ditch

The objectives of this investigation are to collect sufficient data to characterize the site and support risk assessment.

Table O-2
Soil Sampling and Analysis

Tier	Unit/Name	PHASE II RI/FS SAMPLE NUMBERS			FIELD[a] - IMMUNOASSAY OR MOBILE LABORATORY					OFF-SITE LABORATORY[b]		
		No. of Locations	Samples/ Location	Total Samples	PAH[c]	PCBs[c]	VOCs[d]	TPH Gas and Diesel[d]	Target Analyte List - Metals[d]	PCBs	Herbicides	Target Analyte List - Metals
Tier 1	Unit 2 - SWMU 273 and Drainage Ditch	6	3	18	X			X	X			
Tier 1 Subtotals				18	18			18	18	18		
Tier 2	Optional: Scope of Tier 2 would be to define extent of shallow soil contamination; based on Tier 1 data, Phase I RI findings, and/or RFA data, with approval of BCT											
Tier 3	Optional: Scope of Tier 3 would be to characterize horizontal and vertical extent of contamination below 10 feet depth; based on Tier 1 and 2 data, Phase I RI findings, and or RFA data, with approval of BCT											

Notes:
[a] four samples from Unit 2 go to the off-site laboratory for confirmation analyses
[b] these constituents cannot be determined in the field; all samples to be analyzed for these constituents will be sent to the off-site laboratory
[c] immunoassay analyses
[d] mobile laboratory analyses

During the Phase I RI, the area of Unit 2 was not sampled. In the Phase II RI/FS, Tier 1 soil samples will be collected at 0, 5, and 10 feet bgs in six areal systematic random sampling locations using a grid spacing of 58 by 13 feet. All soil samples will be field screened for polynuclear aromatic hydrocarbons (PAH) by immunoassay test kits (U.S. EPA Method 4035), and total petroleum hydrocarbons (TPH) (U.S. EPA Method 8105M) and TAL metals (U.S. EPA Method 6000/7000) by a mobile laboratory. For quality assurance/quality control support and verification, four samples (three detect and one nondetect) will be submitted to the fixed-base laboratory to confirm field screening results. These fixed-base analyses are PAH (U.S. EPA Method 8310), TPH (U.S. EPA Method 8015M), and TAL metals (U.S. EPA Method 6000/7000) under NFESC Level D protocols. Attachment O in the FSP provides the sampling procedures for the Phase II RI/FS at Site 15, Unit 2 (BNI 1995).

Tier 2

The primary objective of the Tier 2 sampling program is to refine the extent of impacted soil identified within each unit by Phase I and/or II RI/FS sampling results. The Tier 2 sampling program will focus exclusively on shallow soil (0 to 10 feet depth) conditions and will further investigate subareas within the unit boundary that exceed PRGs.

The Tier 2 sampling plan will be developed after an evaluation of Phase I RI/FS and/or Phase II RI Tier 1 analytical results. If a Tier 2 sampling program meets the DQOs for this unit, the decision to proceed will be based upon the criteria described in DQO Steps 2, 3, and 5. The proposed Tier 2 sampling plan, with recommendations, will be reviewed by the Base Realignment and Closure (BRAC) Cleanup Team (BCT). The BCT will decide whether the proposed Tier 2 sampling program will be implemented by the Navy.

TIER 2 SOIL SAMPLING

The objective of a Tier 2 sampling program is to refine the extent of impacted shallow soil within the unit being investigated. The rationale for accomplishing this objective depends primarily on the size and layout of the unit. Where the unit is a linear feature such as a drainage ditch, the Tier 2 program will focus sampling along the trend of the ditch bracketing the Tier 1 sampling locations (or Phase I RI/FS sample locations) where analyte concentrations exceeding PRGs are reported.

For units of rectangular, roughly circular, or irregular dimensions, a systematic random sampling based on a grid, stratified random sampling, or judgmental sampling approach will be used to define the extent of the Tier 1 sample location(s) where analyte concentrations exceeded PRGs. The limits of the area covered by these sampling approaches will be contingent upon the distribution of adjacent Tier 1 sample locations in which the COPCs were not detected.

The number of Tier 2 sampling locations (i.e., grid spacing) will be selected to achieve the following objectives:

- provide the areal coverage necessary to define the extent of shallow impacted soil, and
- minimize the cost associated with field and fixed-base laboratory sample testing.

The spacing between sampling locations for Tier 2 will be contingent upon the estimated size of the area to be investigated, and the spacing between Phase I or II RI/FS sample locations. Tier 2 soil sample depth intervals and chemical analyses will conform to those specified for Tier 1 soil sampling.

Tier 3

The Tier 3 sampling program would only be implemented at a unit where Phase I RI data or the initial evaluation of the Phase II RI Tier 1 and/or Tier 2 sampling program results suggest that soil contamination may extend to depths greater than 10 feet bgs.

The objectives of the Tier 3 sampling program are to estimate the horizontal and vertical extent of impacted subsurface soil (greater than 10 feet bgs) and assess whether groundwater beneath the site has been impacted by historic site activities. If impacted subsurface soil is limited to the vadose zone above the water table or vadose zone modeling does not suggest a potential for COPCs to impact groundwater, then groundwater quality will not be investigated.

The Tier 3 sampling plan will be developed after an evaluation of Phase I RI/FS and Phase II RI Tier 1 and/or 2 analytical results. If a Tier 3 sampling program meets the DQO for this unit, then the decision to proceed will be based upon the criteria described in DQO Steps 2, 3, and 5. The proposed Tier 3 sampling plan, with recommendations, will be reviewed by the BCT. The BCT will decide whether the proposed Tier 3 sampling program will be implemented.

Optimization of Sampling Plan

As soil analytical data becomes available from sampling in each unit, investigative plans for the site will be optimized. The proposed tiered sampling approach is an iterative process that will permit data from one tier to be evaluated prior to the implementation of the next tier of sampling. The iterative process involves review of data, recommendations for further actions, and approval of the BCT. In this way, the investigation can be optimized by performing the least amount of sampling necessary to assist the decision making process about future actions at the unit (i.e., NFI, Early Action, and Long-Term Action).

References

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BNI. *See* Bechtel National, Inc.

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Jacobs Engineering Group, Inc. 1993a. *Installation Restoration Program, Phase I Remedial Investigation Draft Technical Memorandum.* Marine Corps Air Station El Toro, California.

———. 1993b. *Installation Restoration Program, Final Resource Conservation and Recovery Act (RCRA) Facility Assessment Report.* Marine Corps Air Station El Toro, California.

———. 1994. *Groundwater Quality Data Report.* Marine Corps Air Station El Toro, California.

LUFT. *See* State of California Leaking Underground Fuel Tank Task Force.

SAIC. *See* Science Applications International Corporation.

Science Applications International Corporation. 1993. *Final Report Aerial Photograph Assessment, Marine Corps Air Station El Toro, El Toro, California.* Science Applications International Corporation.

State of California Leaking Underground Fuel Tank Task Force. 1989. *Leaking Underground Fuel Tank Field Manual: Guidelines for Site Assessment, Cleanup, and Underground Storage Tank Closure.*

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U.S. EPA. *See* United States Environmental Protection Agency.

WORK PLAN APPENDIX P

DATA QUALITY OBJECTIVES
OPERABLE UNIT 3 –
SITE 16 – CRASH CREW PIT NO. 2

SUMMARY

STEP 1 – STATE THE PROBLEM

Site 16, Crash Crew Pit No. 2, was used to train firefighters from approximately 1972 until 1985. The site contained three pits, one of which, the main pit, is still present. Fuels and other fluids (JP-5, leaded aviation gasoline, hydraulic fluid, and waste oil) that were used for burning in these pits have contaminated soil beneath the site. Total fuel hydrocarbon-contaminated soil is present to a depth of approximately 60 feet below ground surface beneath the main pit. The human health and ecological risks associated with the contaminated soil will be estimated so that a No Further Investigation, Early Action, or the appropriate remedial alternative can be recommended.

STEP 2 – IDENTIFY THE DECISION

The Phase II Remedial Investigation/Feasibility Study decisions to be considered at Site 16 are as follows: Do chemicals of potential concern in the shallow soil at Site 16 present an unacceptable risk to human health and the environment? Do the chemicals of potential concern present in the subsurface soil (> 10 feet below ground surface) present an unacceptable risk to groundwater? The possible decision outcomes are recommendations for No Further Response Action Planned, Early Action, or Long-Term Action.

STEP 3 – IDENTIFY THE INPUTS AFFECTING THE DECISION

Inputs necessary to make these decisions include a list of chemicals of potential concern; the extent of impacted media; the background (ambient) concentrations of metals, herbicides, and pesticides; and the action levels for protection of human health and the environment.

STEP 4 – DEFINE THE BOUNDARIES OF THE STUDY

The study is limited to the geographic area of Site 16, which comprises three subareas: 1) the Pit Perimeter Area (approximately 16,250 feet^2); 2) the Fire Fighting Pits (approximately 4,340 feet^2); and 3) the Drainage Channel (approximately 10,200 feet^2) located near the crash crew pits.

STEP 5 – DEVELOP A DECISION RULE

Action levels developed for decision-making purposes are a cumulative excess cancer risk of 10^{-6} in humans and a hazard index of 1.0 for chronic systemic toxicity in humans. Based on these risk levels, decision rules have been formulated to protect human health and the environment in residential, recreational, and industrial land use scenarios.

STEP 6 – SPECIFY LIMITS ON UNCERTAINTY

The number of samples necessary to estimate different levels of risk were calculated using the confidence level of 95 percent and power level of 80 percent limits specified for this project. The preliminary cancer and noncancer risk values were compared to the risk levels, and the appropriate number of samples necessary to estimate risk were selected for each unit.

STEP 7 – OPTIMIZE THE DESIGN

Shallow soil samples will be collected and analyzed at 0, 5, and 10 feet below ground surface at three locations in the Pit Perimeter Area, four locations in the Fire Fighting Pits, and three locations in the Drainage Channel. In addition, at least three deep borings will be drilled in the area of boring 16AB213 to vertically delineate total fuel hydrocarbon impacted soil in this area.

ACRONYMS/ABBREVIATIONS

AOC	area of concern
ARAR	applicable or relevant and appropriate requirement
BCT	BRAC Cleanup Team
bgs	below ground surface
BRAC	Base Realignment and Closure
BTEX	benzene, toluene, ethylbenzene, and xylenes
COPC	chemical of potential concern
CRDL	contract-required detection limit
DQO	data quality objective
EE/CA	Engineering Evaluation/Cost Analysis
FS	Feasibility Study
FSP	Field Sampling Plan
IDL	instrument detection limit
LUFT	(California) Leaking Underground Fuel Tank (Field Manual)
MCAS	Marine Corps Air Station
MCL	maximum concentration levels
µg/kg	micrograms per kilogram
µg/L	micrograms per liter
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
NEESA	Naval Energy and Environmental Support Activity
NFESC	Naval Facilities Engineering Service Center
NFI	No Further Investigation
PAH	polynuclear aromatic hydrocarbons
PRG	(U.S. EPA Region IX) Preliminary Remediation Goal
QA/QC	quality assurance/quality control
RCRA	Resource Conservation and Recovery Act
RFA	RCRA Facilities Assessment
RI	Remedial Investigation

ACRONYMS/ABBREVIATIONS (continued)

SVOC	semivolatile organic compound
SWMU	solid waste management unit
TAL	target analyte list
TDS	total dissolved solids
TFH	total fuel hydrocarbons
TPH	total petroleum hydrocarbons
TRPH	total recoverable petroleum hydrocarbons
U.S. EPA	United States Environmental Protection Agency
UST	underground storage tank
VOC	volatile organic compound

Appendix P
SITE 16 – CRASH CREW PIT NO. 2

The United States Environmental Protection Agency (U.S. EPA) developed the data quality objectives (DQO) process as a tool for project managers to determine the type, quantity, and quality of data needed to make decisions. Data produced by sampling and monitoring activities are used extensively in problem definition, rule-making, and enforcement decisions. These activities are supported through implementation of the mandatory U.S. EPA Quality System, which requires all organizations to develop and operate management processes and structures for assuring that the data collected are of the necessary and expected quality for their desired use (U.S. EPA 1993).

The U.S. EPA DQO process consists of the following seven steps.

1. **State the problem:** Describe the problem at the site as it is currently understood. The problem statement includes a site conceptual model and an organization and review of all relevant data.
2. **Identify the decision:** Determine an if-then statement that will define what the investigation will seek to determine and what actions will be taken based on the possible outcomes of the investigation.
3. **Identify inputs into the decision:** Specify the analytes or parameters to be measured and used.
4. **Define the study boundary:** Delineate the study boundary from information obtained from Step 1.
5. **Develop a decision rule:** Restate the decision detailing the if-then statement in specific terms.
6. **Specify acceptable limits on decision errors:** Specify how the data will be treated statistically and what the acceptable limits of uncertainty are.
7. **Optimize the design:** Design the field investigation, giving adequate consideration to the results of Steps 5 and 6. This step is described in more detail in the Field Sampling Plan (FSP).

The following sections describe the DQO process for Site 16 – Crash Crew Pit No. 2.

STEP 1 – STATE THE PROBLEM

Site 16 was previously used to train firefighters from approximately 1972 until 1985. Fuels and other fluids (JP-5, leaded aviation gasoline, hydraulic fluid, and waste oil) that were used for burning in these pits have contaminated soil beneath the site. Total fuel hydrocarbon (TFH)-contaminated soil is present to a depth of approximately 60 feet below ground surface (bgs) beneath the main pit. The human health and ecological risks associated with the impacted soil will be estimated so that a No Further Investigation (NFI), Early Action, or the appropriate remedial alternative can be recommended.

Site Description

Site 16, Crash Crew Pit No. 2, is located in the center of the airfield, near the intersection of Runways 34-16 and 25-07 (Figure P-1). The site is relatively flat, and surface drainage from the site appears to flow northwest into a drainage channel which discharges into Bee Canyon Wash. Contained on the site were three pits, the main pit is still present (Figure P-2).

Site boundaries for Marine Corps Air Station (MCAS) El Toro Phase I Remedial Investigation (RI) were determined by consensus between the Navy and regulatory agencies prior to initiation of the Phase I RI. Areas of concern (AOCs) were generally grouped together into sites based on common historical activities, aerial photograph review, and their respective locations to each other. Site 16 consisted of three areas for the Phase I RI: 1) the disturbed-ground area (including the two filled pits); 2) main fire-fighting pit; and 3) the drainage channel.

The main pit, used for large fire-fighting training exercises, is about 50 to 60 feet in diameter and 3 feet deep. During training, the pit was filled with water and covered with various mixtures of residual fuels and fluids (JP-5 fuel, leaded aviation gasoline, hydraulic fluid, crankcase oil), and the mixture was then ignited. The main pit was connected by a drain pipe to a secondary pit approximately 40 feet away, which was about 12 by 35 feet, and 4 to 5 feet deep. The secondary pit stored residual liquids from the main pit. The third pit measured about 10 feet by 3 feet and was used for training with hand-held extinguishers. An estimated 275,000 gallons of residual fluids may have been placed in the three pits. Small quantities of napalm, white phosphorus, and magnesium phosphate were also reportedly burned (Jacobs Engineering 1993a).

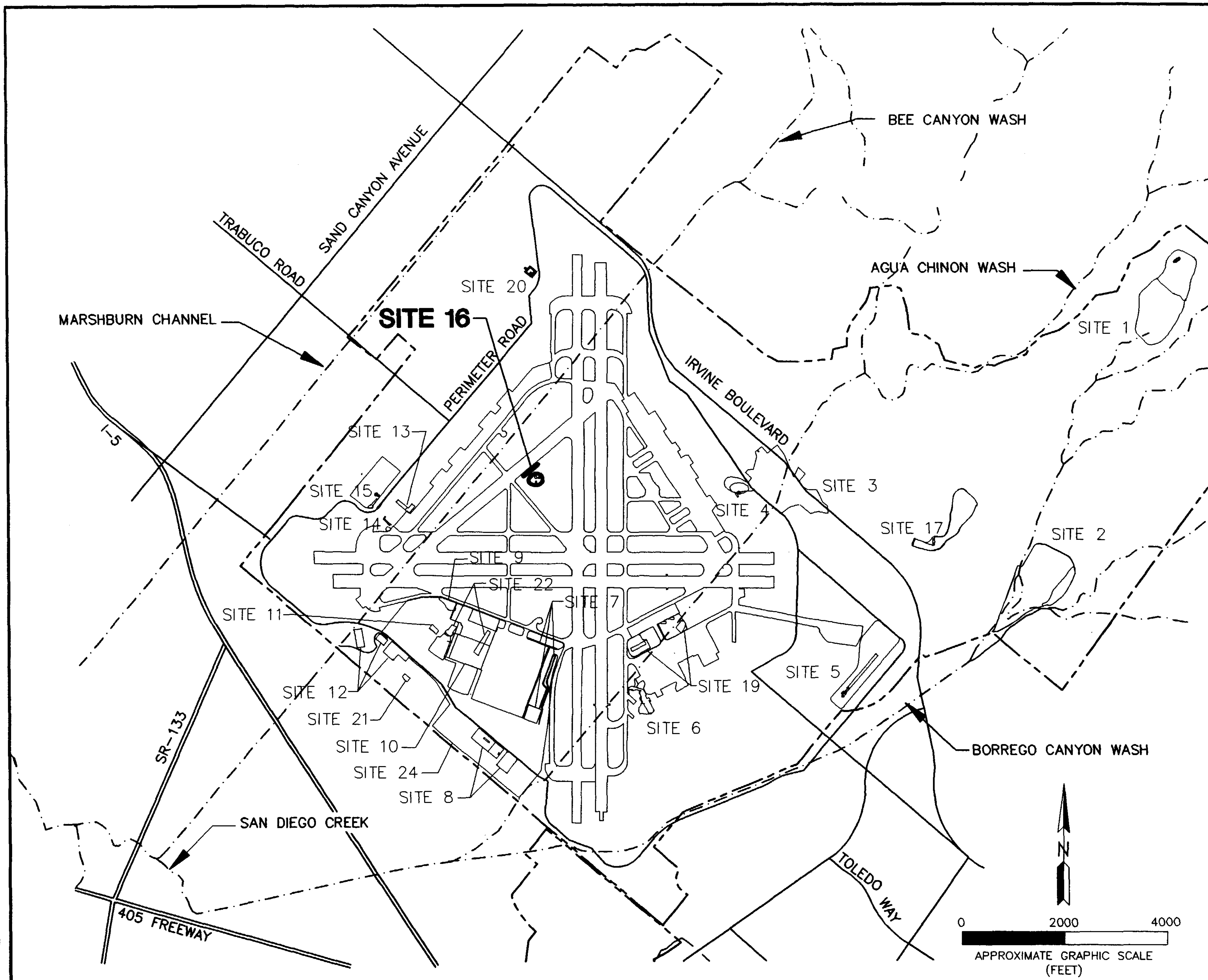
The current crash crew pits are located adjacent (southeast) to Site 16. Evaluation of these pits will be included under the Base Closure Plan.

Previous Investigations

Several investigations have been conducted in the area of Site 16, these are the Resource Conservation and Recovery Act (RCRA) Facilities Assessment (RFA), Phase I RI, aerial photograph surveys, and employee interviews. The sections below provide a summary of these investigations.

RCRA FACILITIES ASSESSMENT

The RFA identified solid waste management unit (SWMU)/AOCs 288, 289, and 290 as being in the area of Site 16 (Jacobs Engineering 1993b). All three of these SWMU/AOCs are underground storage tanks (USTs) outside Site 16 boundaries and remain in use as part of the drainage system for the operational crash crew pit. It is anticipated that SWMU/AOCs 288, 289, and 290 will be evaluated under the MCAS El Toro UST Investigation (Jacobs Engineering 1993c).



Work Plan Appendix P
Figure P-1
Site Location
Site 16 - Crash Crew Pit No. 2

MCAS El Toro, California

CLEAN II Program

Date: 6/13/95
File No. slocr-16
Job No. 22214-059

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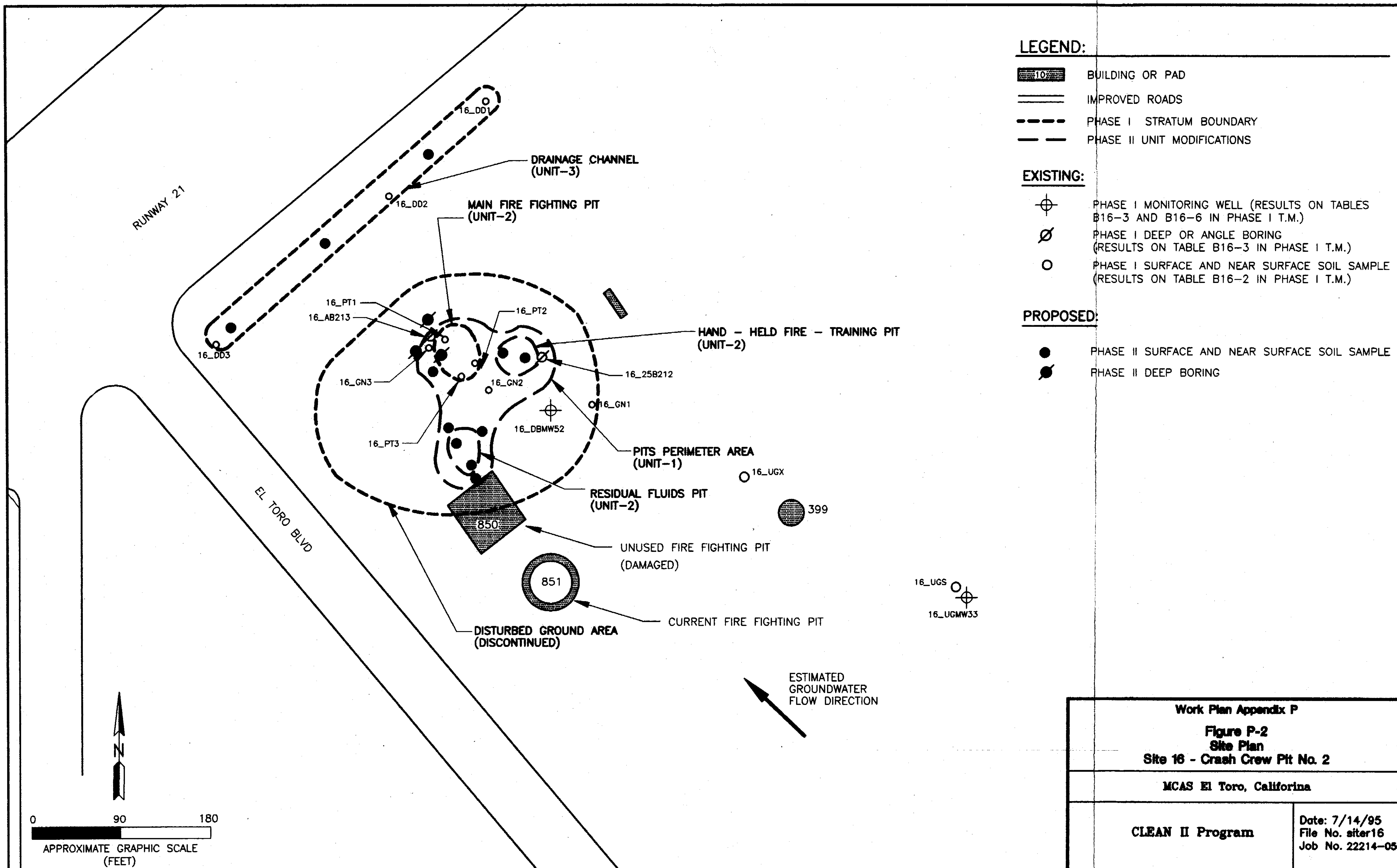
LEGEND:
10
BUILDING OR PAD
IMPROVED ROADS
PHASE I STRATUM BOUNDARY
PHASE II UNIT MODIFICATIONS
EXISTING:
PHASE I MONITORING WELL (RESULTS ON TABLES B16-3 AND B16-6 IN PHASE I T.M.)
PHASE I DEEP OR ANGLE BORING (RESULTS ON TABLE B16-3 IN PHASE I T.M.)
PHASE I SURFACE AND NEAR SURFACE SOIL SAMPLE (RESULTS ON TABLE B16-2 IN PHASE I T.M.)
PROPOSED:
PHASE II SURFACE AND NEAR SURFACE SOIL SAMPLE
PHASE II DEEP BORING
RUNWAY 21
16_DD1
16_DD2
16_DD3
DRAINAGE CHANNEL (UNIT-3)
MAIN FIRE FIGHTING PIT (UNIT-2)
16_PT1
16_AB213
16_PT2
16_GN3
16_GN2
16_GN1
16_25B212
16_PT3
16_DBMW52
HAND - HELD FIRE - TRAINING PIT (UNIT-2)
PITS PERIMETER AREA (UNIT-1)
16_UGX
RESIDUAL FLUIDS PIT (UNIT-2)
399
850
UNUSED FIRE FIGHTING PIT (DAMAGED)
851
CURRENT FIRE FIGHTING PIT
16_UGS
16_UGMW33
DISTURBED GROUND AREA (DISCONTINUED)
EL TORO BLVD
ESTIMATED GROUNDWATER FLOW DIRECTION
N
0
90
180
APPROXIMATE GRAPHIC SCALE (FEET)
Work Plan Appendix P
Figure P-2
Site Plan
Site 16 - Crash Crew Pit No. 2
MCAS El Toro, Califorina
CLEAN II Program
Date: 7/14/95
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Job No. 22214-059

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PHASE I REMEDIAL INVESTIGATION

For the Phase I RI, subareas within sites were designated as strata. Due to the fact that some new subareas have been added or subareas have been expanded or diminished for the Phase II RI/Feasibility Study (FS), subareas within sites will be referred to as units for the Phase II RI/FS. In this section, discussion is related to Phase I RI sampling and results, and the term strata will be used. Following this section, the term unit will be used.

During the Phase I RI, Site 16 was divided into three strata (Figure P-2):

- Stratum 1– Disturbed-Ground Area (including the two filled pits);
- Stratum 2 – Main Fire-Fighting Pit; and
- Stratum 3 – Drainage Channel.

The following site-specific activities were conducted:

- twenty-seven surface and near surface soil samples were collected (0 to 4 feet bgs) from 11 locations;
- twenty-two subsurface (vadose zone) samples were collected from five borings;
- three groundwater monitoring wells were installed and sampled;
- soil samples were analyzed for target analyte list (TAL) metals, volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), total recoverable petroleum hydrocarbons (TRPH), TFH-diesel and gasoline, dioxin and furans; and
- groundwater samples were analyzed for TAL metals, VOCs, SVOCs, pesticides and polychlorinated biphenyls, herbicides, TRPH, TFH, general chemistry.

A summary of the ranges of analyte concentrations detected during the Phase I RI (sample identification of the highest concentration is provided) and recent groundwater monitoring data are presented below. All chemicals of potential concern (COPCs) that were detected in soil are listed with the exception of specific metals which are listed only if they exceed U.S. EPA Region IX Preliminary Remediation Goals (PRGs) or ecological screening criteria in shallow soil. All COPCs that exceed PRGs or maximum concentration levels (MCLs) in groundwater are included in this list. If a minimum concentration is recorded with a "less than" symbol, it denotes a concentration below the contract laboratory program detection limit. Sample locations are shown on Figure P-2. A complete listing of all detected chemicals is presented in the Phase I RI Technical Memorandum, Appendix B-16, Tables B16-2 through B16-7, (Jacobs Engineering 1993a), and in the Groundwater Quality Data Report (Jacobs Engineering 1994a). TAL metals that were analyzed during the Phase I RI are beryllium, barium, arsenic, antimony, aluminum, cadmium, calcium, cobalt, copper, iron, lead, magnesium, manganese, mercury, nickel, potassium, selenium, silver, sodium, thallium, vanadium, and zinc.

Shallow Soil (< 10 feet below ground surface)

- metals: lead (0.79 to 291 milligrams per kilogram [mg/kg] [16_GN3 at 0 feet]), zinc (18.7 to 198 mg/kg [16_GN3 at 0 feet), and 20 other TAL metals.
- VOCs: 2-butanone (< 10 to 13,000 micrograms per kilograms [μg/kg] [16_PT2 at 4 feet]), 2-hexanone (< 10 to 3J μg/kg [16_DD3 at 2 feet]), acetone (< 10 to 1,100J μg/kg [16_PT1 at 2 feet]), benzene (< 10 to 30J μg/kg [16_PT2 at 2 feet]), carbon tetrachloride (< 10 to 4J μg/kg [16_DD3 at 0 feet]), ethylbenzene (< 10 to 1,700 μg/kg [16_PT2 at 4 feet]), methylene chloride (< 10 to 50JB μg/kg [16_GN3 at 0 feet]), toluene (< 10 to 1,700 μg/kg [16_PT2 at 4 feet]), xylenes (< 10 to 23,000 μg/kg [16_PT3 at 4 feet]);
- SVOCs: 2-methylnaphthalene (< 670 to 3,300 μg/kg [16_PT1 at 0 feet]), bis(2-ethylhexyl) phthalate (< 670 to 520J μg/kg [16_PT3 at 4 feet]), dibenzofuran (< 670 to 990 μg/kg [16_PT2 at 4 feet]), fluoranthene (< 670 to 2,000 μg/kg [16_GN3 at 0 feet]), naphthalene (< 670 to 33,000D μg/kg [16_PT2 at 4 feet]), phenanthrene (< 670 to 870J μg/kg [16_PT3 at 4 feet]); and
- fuel and petroleum hydrocarbons: TFH-diesel (< 12.9 to 75,200 mg/kg [16_PT3 at 4 feet]), TFH-gasoline (< 0.053 to 3,120 mg/kg [16_PT3 at 4 feet]), TRPH (< 20 to 39,101J mg/kg [16_PT3 at 4 feet]).

Subsurface Soil (> 10 feet below ground surface)

- metals: 22 of 23 TAL metals
- VOCs: 2- butanone (< 10 to 14,000 μg/kg), acetone (< 10 to 2,300J μg/kg), ethylbenzene (< 10 to 2,300J μg/kg), methylene chloride (< 10 to 910J μg/kg), toluene (< 10 to 2,400J μg/kg), xylenes (< 10 to 9,900 μg/kg);
- SVOCs: 2-methylnaphthalene (< 680 to 840J μg/kg), naphthalene (< 690 to 26,000 μg/kg); and
- fuel and petroleum hydrocarbons: TFH-diesel (< 13.1 to 40,000 mg/kg), TFH-gasoline (< 0.052 to 6,440 mg/kg), TRPH (< 20 to 5,524 mg/kg).

Groundwater (16_UGMW33 upgradient)

- general chemistry: chloride (8.63 to 19.5 milligrams per liter [mg/L]), nitrate/nitrite-N (5.21 to 5.84 mg/L), sulfate (192 to 201 mg/L), total dissolved solids (TDS) (639 to 677 mg/L);
- metals: antimony (14.6B to 17.2B micrograms per liter [μg/L]), arsenic (3.9B to 17 μg/L), manganese (1.5B to 5.1B μg/L), selenium (1.7B to 34.2B μg/L), and 10 other TAL metals; and
- VOCs: chloroform (< 1 to 0.4J μg/L), methyl chloride (< 1 to 0.5J μg/L), trichloroethene (< 1 to 0.8J μg/L).

Groundwater (16_DBMW52 on-site)

- general chemistry: chloride (305 to 311 mg/L), nitrate/nitrite-N (22.3 to 22.5 mg/L), sulfate (369 to 408 mg/L), TDS (1,360 to 1,380 mg/L); and
- metals: antimony (20.5B to 20.8B μg/L), cadmium (< 1.4 to 8.7 μg/L), manganese (12B to 157 μg/L), nickel (184 to 497 μg/L), selenium (25.2 to 37.5 μg/L), and nine other TAL metals.

Groundwater (16_DGMW81 downgradient)

- general chemistry: chloride (406 to 429 mg/L), nitrate/nitrite-N (21 to 25.1 mg/L), sulfate (660 to 722 mg/L), TDS (2,040 to 2,350 mg/L); and
- metals: antimony (< 20.3 to 20.4B μg/L), cadmium (< 1.4 to 4.1B μg/L), manganese (3.7B to 110 μg/L), nickel (229 to 547μg/L), selenium (144 to 192 μg/L), and nine other TAL metals.

D = Indicates value for this compound is from a diluted analysis.

J = Indicates an estimated value for qualitative use only (organic parameters).

B = Indicates reported value is less than the contract-required detection limit (CRDL), but greater than the or equal to the instrument detection limit (IDL) (inorganic parameters).

PRGs and ecological screening criteria were compared with corresponding shallow soil analytical results. The results are as follows:

- no COPCs detected in shallow soil exceed PRGs; and
- lead and zinc exceed ecological screening criteria in shallow soil in Stratum 1.

Petroleum hydrocarbons detected in shallow soil were compared to California Leaking Underground Fuel Tank (LUFT) Field Manual guidelines (LUFT 1989) to evaluate their potential to migrate to the groundwater. Based on LUFT guidelines, petroleum hydrocarbons in the shallow soil at Site 16 may pose a threat to groundwater. TFH-impacted soil is present to a depth of at least approximately 60 feet bgs in the area of boring 16AB213 (Jacobs Engineering 1993a).

Groundwater samples were collected from the three groundwater monitoring wells constructed in the area of Site 16 and compared to applicable human health PRGs and MCLs. The results are as follows:

- antimony and nitrate in groundwater in the one downgradient well (16_DGMW81) and the on-site well (16_DBMW52) exceed human health risk-based screening criteria;
- arsenic exceed PRGs in UGMW33 (upgradient well);
- cadmium, nickel, and nitrate exceed primary MCLs in the on-site and downgradient wells;
- antimony and selenium exceed primary MCLs in all three wells;

- chloride, manganese, and sulfate exceed secondary MCLs in the on-site and downgradient wells; and
- TDS exceed secondary MCLs in all three wells.

Although surface and subsurface soil samples indicated the presence of fuel petroleum hydrocarbons and various VOCs and SVOCs in shallow soil in all three strata, the results of groundwater sampling did not indicate the presence of these compounds in groundwater (Jacobs Engineering 1993a).

U.S. EPA AERIAL PHOTOGRAPH SURVEY

The results of the U.S. EPA Aerial Photo Survey performed for MCAS El Toro indicate the first site-related features on Site 16 are visible on the photograph from 1980. An area of approximately 250 by 400 feet of disturbed earth and a circular impoundment near the center of the site are visible. In the 1991 photograph, the same features are present; however, the area has been partly revegetated (Jacobs Engineering 1993a).

SCIENCE APPLICATIONS INTERNATIONAL CORPORATION AERIAL PHOTOGRAPH SURVEY

The Science Applications International Corporation survey identified a circular impoundment in the area of Site 16 with possible liquid (the main fire-fighting pit) on the 1974 photograph. On the 1984 photograph, a rectangular impoundment (the fuel and water pit) is evident (SAIC 1993).

EMPLOYEE INTERVIEWS

On 26 May 1994, a meeting was held at MCAS El Toro to interview active and retired personnel from the Station Fuel Operations Division and Facility Management Department (currently the Installations Department) with knowledge of Station operations and procedures for storage/disposal of hazardous materials and waste. Participating as interviewers during the meeting were agency personnel, Navy and Station personnel, and personnel from the contractors for the Navy and the U.S. EPA. During these interviews the following information pertaining to Site 16 was obtained (Jacobs Engineering 1994b):

- the panel recalled that a crash crew station was located in this general area; and
- the crash crew station was located near the center of the airfield and provided subsurface shelter to the crash crew in case of an emergency.

Geology

The geology of Site 16 consists of Quaternary alluvial and marine deposits (Jacobs Engineering 1993a). Holocene deposits consist of fine-grained overbank deposits and coarse-grained stream channel deposits. These soils are derived from the Santa Ana Mountains to the east and conformably overlie Pleistocene interbedded fine-grained lagoonal and near-shore marine deposits. Pleistocene deposits could not be differentiated from Holocene deposits in Phase I RI soil borings. Pleistocene deposits unconformably overlie semiconsolidated marine sandstones, siltstones, and conglomerates of late Miocene to late Pliocene, which are considered to be bedrock in the area. Based on a review of boring logs from the Phase I RI, subsurface lithology at Site 16 consists of lenses of clay, silt, sandy silt, silty sand and sand (Jacobs Engineering 1993a).

Hydrogeology

MCAS El Toro lies within the Irvine Groundwater Basin, which is a subbasin of the Los Angeles groundwater basin. Regional aquifers in the Irvine Subbasin tend to be composed of discontinuous lenses of clayey and silty sands and fine-grained gravels contained within a complex assemblage of sandy clays and sandy silts. Three general aquifer systems have been identified near the Station: a shallow and perched system, a principal aquifer zone, and a lower hydrogeologic system existing in bedrock (Jacobs Engineering 1993a).

The Phase I RI results indicate that the shallow, perched zone is not present at Site 16. The principal aquifer is present beneath Site 16 at a depth of about 180 feet bgs. The regional groundwater flow direction is to the northwest. The local hydraulic gradient has been influenced strongly by the pumping of irrigation wells located west of MCAS El Toro.

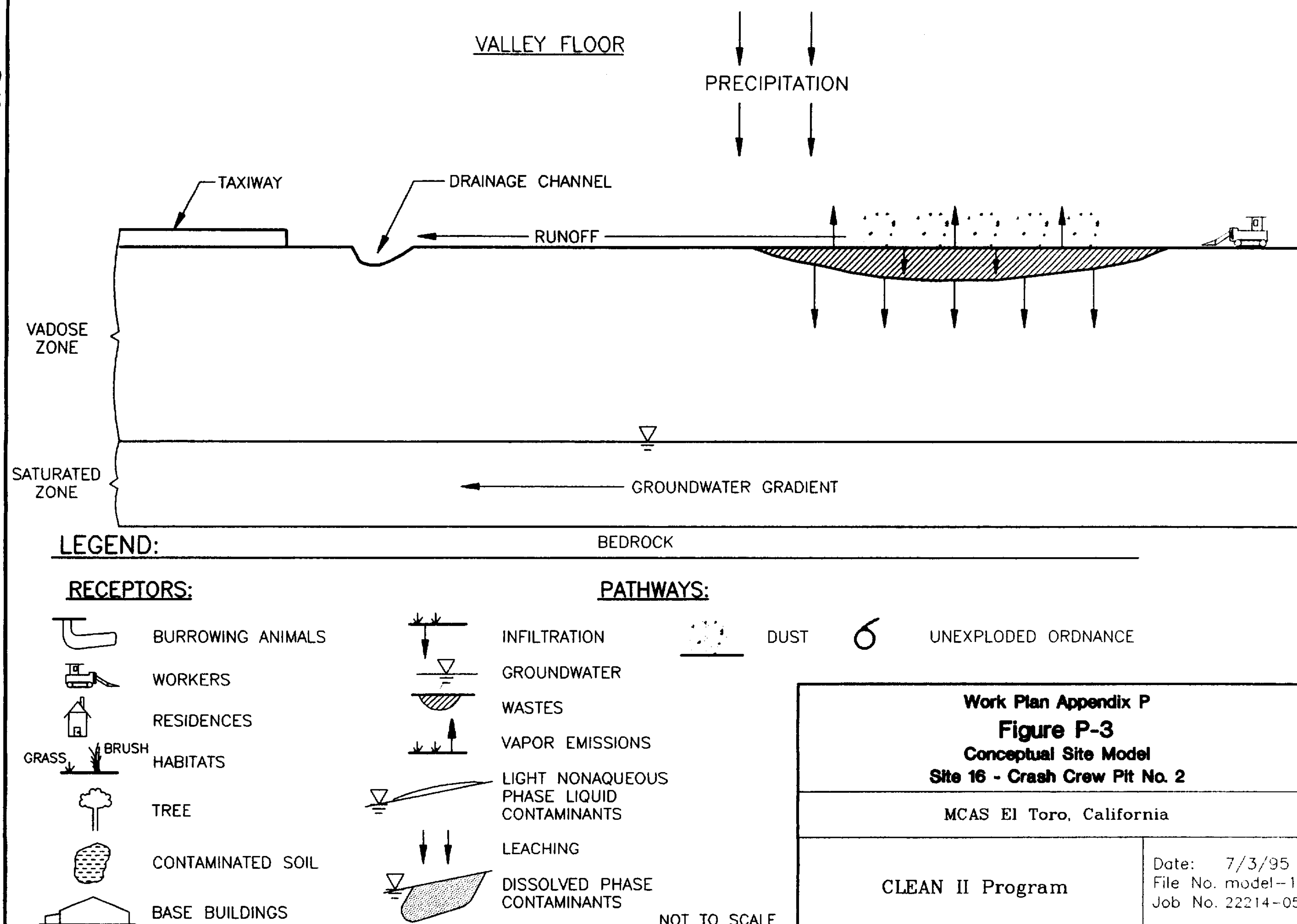
Conceptual Site Model

In the process of developing a conceptual site model, release mechanisms and potential sources of contamination were considered and evaluated to determine their applicability to the site. Also considered in the development of the conceptual site model were potential receptors and contaminant pathways to potential receptors. Figure P-3 illustrates the conceptual site model developed for the site. Figure P-4 depicts the potential exposure routes and pathways for human and ecological receptors.

The primary release mechanism is contaminants that are released to shallow soil from disposal activities at this site. Eventually under gravity, contaminants present in shallow soil may move downward with soil moisture (in a dissolved phase) or in a liquid phase. The depth of groundwater is recorded to be about 180 feet bgs.

The secondary source of contaminants is the surrounding soil impacted by disposal activities. One secondary release mechanism is the dust brought into suspension in the air by wind. The fine particles of dust may contain all potential contaminants. Storm water runoff may form another secondary release mechanism. Storm water carries contaminants in dissolved forms, colloidal forms, or forms associated with suspended soil particles.

The potential pathways are air, groundwater, and surface water. Airborne contaminants are transported through fugitive dust and volatilization. The transport through air is affected by wind speed and direction, type of contaminant, and weather conditions. Typically, wind at MCAS El Toro is from west/southwest at less than 10 knots.



Work Plan Appendix P

Figure P-3

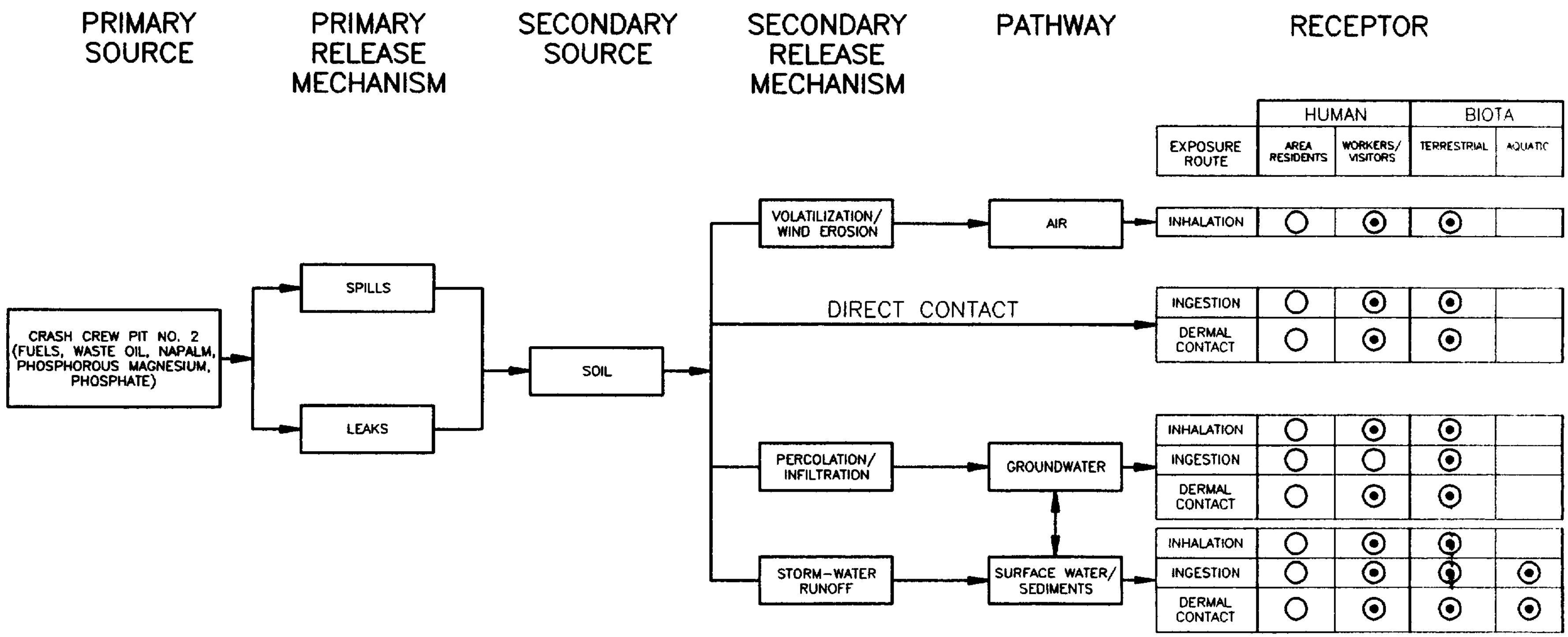
Conceptual Site Model

Site 16 - Crash Crew Pit No. 2

MCAS El Toro, California

CLEAN II Program

Date: 7/3/95
File No. model--16
Job No. 22214-059



LEGEND:

● CURRENT POTENTIAL RECEPTOR

○ FUTURE POTENTIAL RECEPTOR

Work Plan Appendix P

Figure P-4

Exposure Routes and Receptors
Site 16 - Crash Crew Pit No. 2

MCAS El Toro, California

CLEAN II Program

Date: 6/28/95
File No. mod16
Job No. 22214-059

Transportation of airborne contaminants through volatilization is expected to be unimportant at this site. Surface water transport is affected by the amount of rainfall, type of contaminant, surface soil properties, and the topography of the area. The mean annual rainfall at MCAS El Toro is about 14.0 inches, most of which occurs from November through April.

Current and/or potential receptors of chemicals at this site via inhalation are workers and visitors involved in disposal activities. Direct contact with surface and subsurface soils is currently possible via dermal or ingestion exposures of workers. Infiltration of contaminated water through the vadose zone into groundwater is possible because subsurface soil is mainly sands, with some silts and clays. However, current exposure of workers is unlikely via ingestion of groundwater at this site.

Terrestrial wildlife could be exposed to chemicals in on-site surface soil, and dust and vapors through ingestion, dermal absorption, or inhalation. Terrestrial plants could also be exposed through root absorption of chemicals in surface soil or deposition of dusts. No special-status species were observed at this site, and the immediate area provides marginal habitat for wildlife species.

Statement of Phase II RI/FS Problem

Site 16 is located in the center of the airfield and was previously utilized to train firefighters. The problems associated with this site are the following:

- shallow and subsurface soil is impacted with VOCs, metals, SVOCs, and fuel hydrocarbons;
- two pits at Site 16 have not been sampled and need to be assessed;
- based on Phase I RI soil sample analyses fuel hydrocarbons in soil may pose a risk to groundwater; and
- more data are necessary to calculate a cumulative excess cancer risk and hazard index for the site.

STEP 2 – IDENTIFY THE DECISION

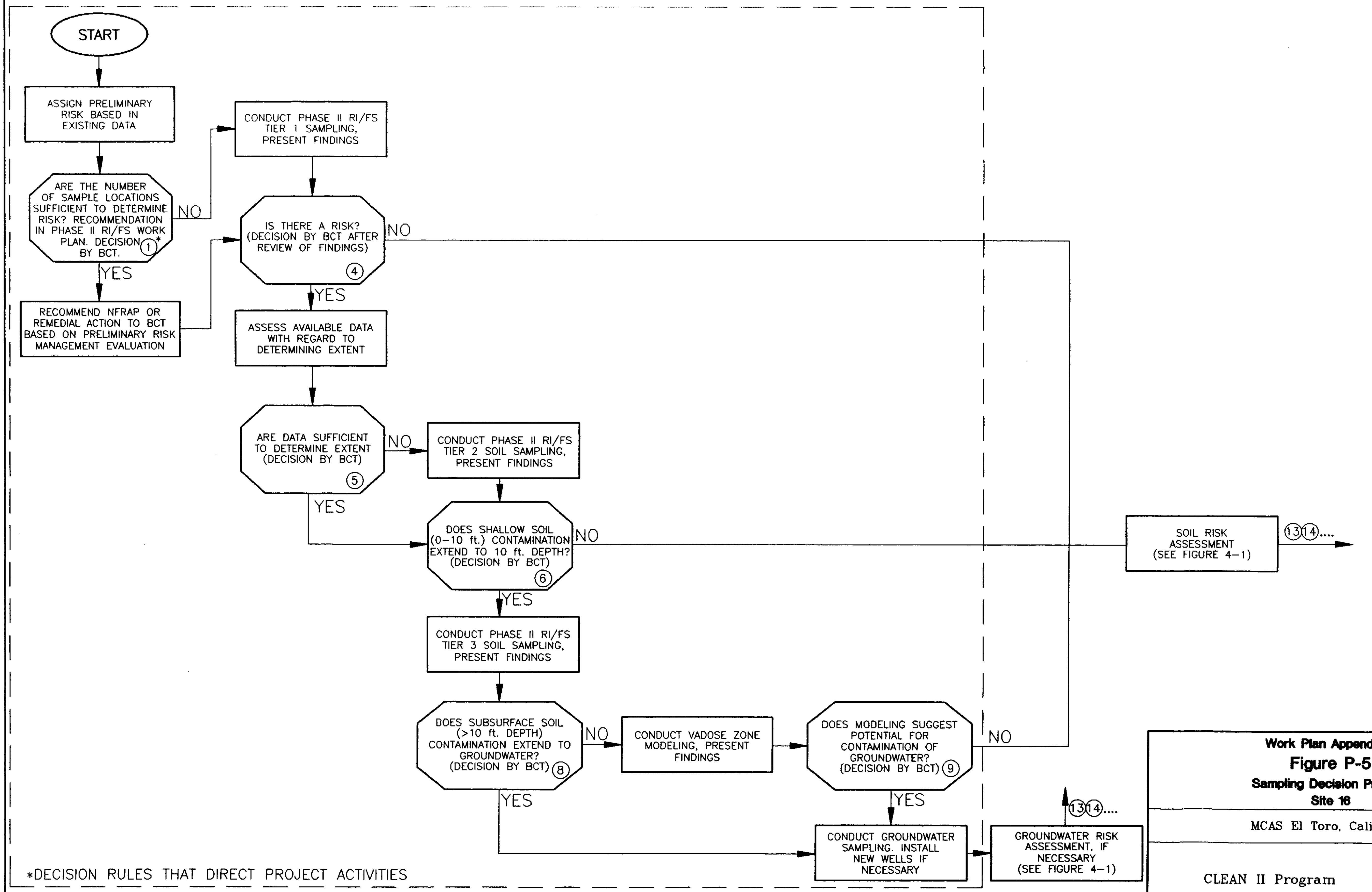
This step describes the decisions that will be considered during the DQO process for Site 16. For each decision, the alternative outcomes are stated. The Sampling Decision Process is illustrated on Figure P-5. For Site 16, the following decisions will be considered:

1. Do COPCs in shallow soil (less than 10 feet bgs) in the unit exceed established background concentrations and PRGs, and/or do they present an unacceptable risk to human health or the environment?

   If yes, proceed to the next decision.

   If uncertain, collect additional soil samples to determine.

   If no, recommend the unit for NFI.



Work Plan Appendix P

Figure P-5

Sampling Decision Process

Site 16

MCAS El Toro, California

CLEAN II Program	Date: 3/11/95 File No. Logicr16 Job No. 22214-059

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2. Has the extent of impacted soil been defined in the shallow soil?

   If yes, evaluate a response action.

   If no, conduct soil sampling to define extent.

3. Does the extent of impacted shallow soil extend into the subsurface (greater than 10 feet bgs)?

   If yes, conduct soil sampling to define vertical extent of impacted soil, and if necessary, evaluate potential impacts to groundwater beneath the site.

   If no, evaluate a response action.

4. Do the media being evaluated for a response action qualify for Early Action?

   If yes, recommend unit for an Engineering Evaluation/Cost Analysis (EE/CA).

   If no, recommend unit for a remedial response as part of the RI/FS process.

STEP 3 – IDENTIFY THE INPUT AFFECTING THE DECISION

Step 2 defined the decisions addressing possible actions at the site. Step 3 will identify the inputs that are required to assess the actions as discussed below.

Inputs for No Further Investigation

Input information required to support a NFI recommendation will also be used to support decisions for Early Action and Long-Term Action. These inputs are as follows:

- list of COPCs;
- definition of the extent of impacted soil;
- background concentrations for metals, pesticides, and herbicides;
- determination of risk for the unit; and
- action levels for the protection of human health and the environment.

Inputs for Early Action

In addition to the inputs required for a NFI recommendation, input information required to support an Early Action recommendation will include the following:

- applicable or relevant and appropriate requirements (ARARs);
- identification of cleanup standards;
- identification of cleanup technology applicability/limitations that are not extensive operation and maintenance activities; and
- site/unit cleanup in less than 5 years.

Inputs for Long-Term Action

In addition to the inputs required for a NFI recommendation, input information required to support a Long-Term Action recommendation may include the following:

- ARARs;
- identification of cleanup standards;
- identification of cleanup technology applicability/limitations;
- pilot testing of remedial alternatives; and
- site/unit cleanup in more than 5 years.

Descriptions of Inputs

The following sections provide brief discussions of the inputs to assess possible response actions.

CHEMICALS OF POTENTIAL CONCERN

The COPCs for Site 16 include all chemicals detected in the Phase I RI for each media and strata. COPCs for Site 16 are listed below.

Shallow Soil (< 10 feet below ground surface)

- metals: aluminum, antimony, arsenic, barium, beryllium, cadmium, cobalt, copper, lead, manganese, mercury, nickel, selenium, silver, thallium, vanadium, zinc;
- VOCs: 2-butanone, 2-hexanone, acetone, benzene, carbon tetrachloride, ethylbenzene, methylene chloride, toluene, xylenes;
- SVOCs: 2-methylnaphthalene, bis(2-ethylhexyl) phthalate, dibenzofuran, fluoranthene, fluorene, naphthalene, phenanthrene, pyrene; and
- fuel and petroleum hydrocarbons: TFH-diesel and -gasoline, TRPH.

Subsurface Soil (> 10 feet below ground surface)

- metals: aluminum, antimony, arsenic, barium, beryllium, cadmium, cobalt, copper, lead, manganese, mercury, nickel, selenium, silver, thallium, vanadium, zinc;
- VOCs: 2-butanone, acetone, ethylbenzene, methylene chloride, toluene, xylenes;
- SVOCs: 2-methylnaphthalene, bis(2-ethylhexyl) phthalate, dibenzofuran, fluoranthene, fluorene, naphthalene, phenanthrene, pyrene; and
- fuel and petroleum hydrocarbons: TFH-diesel and -gasoline, TRPH.

Groundwater – Upgradient

- metals: antimony, arsenic, barium, chromium, copper, manganese, selenium, vanadium, zinc;
- VOCs: chloroform, methylene chloride, trichloroethene; and
- fuel and petroleum hydrocarbons: TFH-diesel and -gasoline.

Groundwater – On-Site

- metals: aluminum, antimony, barium, cadmium, chromium, cobalt, manganese, nickel, selenium, vanadium; and
- fuel and petroleum hydrocarbons: TFH-diesel and -gasoline.

Groundwater – Downgradient

- metals: aluminum, antimony, barium, cadmium, copper, manganese, mercury, nickel, selenium, silver, vanadium; and
- fuel and petroleum hydrocarbons: TFH-diesel and -gasoline.

THE NATURE AND EXTENT OF CONTAMINATION

Phase II RI/FS sample locations, depths, and chemical analyses have been designed to assess the risk associated with the site. Additional sampling will be conducted if it is necessary to further define the extent of impacted shallow soil, subsurface soil, or groundwater.

BACKGROUND CONCENTRATIONS

The background concentrations for metals, herbicides, and pesticides are presented in Section 4 of the Phase II RI/FS Work Plan.

DETERMINATION OF RISK

A determination of the human health risk associated with each site is based on a baseline or streamline risk assessment. Baseline risk assessments are performed on RI/FS sites. The objective of a baseline risk assessment is to estimate the risks associated with the no action alternative and thereby provide decision makers information useful in identifying the most appropriate remedial action alternative. The risk estimates produced also serve as a benchmark to which reductions in risk achieved by remedial actions may be compared. Streamlined risk assessments are performed on removal action sites to support the removal action.

In addition to the human health risk assessment conducted for a site, an ecological risk assessment may also be performed. The ecological risk assessment will evaluate current and potential risks to the environment posed by the chemical releases that have occurred at the sites.

IDENTIFICATION OF CLEANUP LEVELS

Cleanup levels will be based on ARARs, background concentrations, and risk levels that will be determined for the site.

CLEANUP TECHNOLOGY EFFECTIVENESS, IMPLEMENTABILITY, AND COSTS

Once cleanup levels have been established, the most appropriate and cost-effective approach will be identified to remediate the site, if necessary.

STEP 4 – DEFINE THE BOUNDARIES OF THE STUDY

This step defines the spatial and temporal boundaries of the problem and any practical constraints that may interfere with the study.

Site 16 will be represented by three units for the Phase II RI/FS (Figure P-2):

- Unit 1 – The Pit Perimeter Area (approximately 16,250 feet^2) contains part of the area of Phase I RI Site 16 Stratum 1; however, the area has been reduced to include only the immediate areas around the pits. Although Site 16, Stratum 1, during the Phase I RI included a larger area (the disturbed ground area), it is thought that native soils were tilled here mainly to prevent potential grass fires during training activities;
- Unit 2 – Fire-Fighting Pits (approximately 4,340 feet^2) consists of the three fire-fighting pits. This unit has the same boundaries as Phase I RI Site 16 Stratum 2; and
- Unit 3 – the Drainage Channel (approximately 10,200 feet^2) has the same boundaries as Phase I RI Site 16 Stratum 3.

Specification of temporal boundaries for the field sampling activities is unnecessary. Shallow and deeper subsurface soil conditions are not considered to be significantly different from conditions during the Phase I RI sampling or throughout the period since spillage or unregulated waste disposal activities occurred on the site.

STEP 5 – DEVELOP A DECISION RULE

Decision rules are required to state explicitly the types of inputs and logical basis for choosing among alternative actions during the Phase II RI/FS. A list of all decision rules for the project are included in Section 4 of the Work Plan. The specific decision rules that will be followed to determine an action are presented here. These decision rules conform to the numbering sequence presented in Section 4 of the Work Plan.

2. If Phase I data are sufficient to assess a response action to reduce risk associated with site units that exceed media action levels or background concentrations, then the cleanup levels and appropriate response action (Early Action or Long-Term Action) will be determined.

3. If Phase I data are not sufficient to assess whether risks are present based on the minimum number of samples, then Tier 1 sampling of the Phase II RI/FS will be completed to supplement the Phase I analytical results so the minimum number of samples is satisfied to assess whether action levels or background concentrations are exceeded in site units.

4. If Phase I data and Tier I data for the Phase II RI/FS indicate that no solid wastes are exposed and respective action levels or background concentrations for the various media of a site unit are not exceeded, then NFI will be recommended.

5. If Phase I data or Tier 1 data of the Phase II RI/FS combined with Phase I data exceed PRGs, action levels, or background concentrations for the various media, then Tier 2 of the Phase II RI/FS sampling and analyses will be conducted to define horizontal and vertical extent, provided additional sampling costs are not more than a potential response action.

6. If PRGs, action levels, or background concentrations for shallow soil are exceeded, and if COPCs detected in the soil extend to 10 feet bgs, then soil below 10 feet bgs (subsurface soil) will be investigated to assess the horizontal and vertical extent of the COPCs.

7. If during the investigation of COPCs in subsurface soil, two consecutive soil sample analyses (at a minimum 5-foot-depth separation) demonstrate that COPCs are not detected, then the vertical extent of soil contamination will be established and investigation of subsurface soil will be halted at that location. The horizontal extent will be established when COPCs are not detected in vertical samples taken at three locations around the sample that exceeds the action levels.

   The lowest detection limit available will be used to define the base of a contaminant plume. COPC detection or quantitation limits that will be compared to establish the base of the contaminant plume include the following:

   - CRDL,
   - contract-required quantitation limit,
   - sample quantitation limit,
   - estimated quantitation limit,
   - practical quantitation limit,
   - method detection limit, and
   - IDL.

8. If during the investigation of COPCs in subsurface soil, it is determined by actual sampling that COPCs extend to the water table, groundwater beneath the site will be investigated for the presence of the COPCs.

9. If COPCs are identified in subsurface soil below 10 feet bgs, above background and action levels, but do not extend to the water table, then vadose zone computer modeling will be used to evaluate the potential for the COPCs to impact groundwater.

10. If it is determined that COPCs in subsurface soil have impacted groundwater causing exceedance of action levels, then the vertical and horizontal extent of groundwater exceedance will be evaluated.

13. If action levels or background concentrations are exceeded for the media of a site unit, then the risk assessment will be initiated, based on sample results, acceptable levels of risk, and potential land uses, to assess potential risks to human health and/or the environment.

14. If unacceptable risks are assessed to human health or the environment, then cleanup levels will be evaluated for each media.

15. If cleanup levels in a given medium are exceeded, and if the site meets at least one of the eight criteria for removal action described in 40 *Code of Federal Regulations* 300.415(b)(2), and the scale and complexity of contaminant distribution in the affected medium are such that excess risk can be expediently reduced utilizing readily available technology, then the medium at the site will be recommended for Early Action.

16. If an early removal action is selected, a non-time-critical EE/CA and Action Memorandum will be completed for the removal action.

17. Once the removal action is completed, the site will be evaluated for residual risk. If a residual risk exists, then a Long-Term Action may be required.

18. If cleanup levels for a given medium are exceeded, and if the site does not meet criteria for an Early Action, then the affected medium will be recommended for long-term remedial action as part of the RI/FS process; and an FS will be completed, followed by a Record of Decision, Remedial Design, and Remedial Action to clean up the site for closure.

STEP 6 – SPECIFY LIMITS ON UNCERTAINTY

The purpose of Step 6 is to specify the tolerance limits for decision errors, which are used by the decision makers to establish performance goals for the data collection design. The objective of the data collection design is to obtain data that reliably estimate the true nature of environmental conditions at Site 16. This process is presented in Section 4 of the Work Plan, and the following subsections present specific information on Site 16.

Identify the Null Hypothesis and Specify the Decision Errors

The null hypothesis for this site specifies that the concentrations of one or more of the COPCs exceed PRGs or risk-based action levels and represent an unacceptable risk at the site.

The alternative hypothesis for this site specifies that the concentrations of one or more of COPCs do not exceed PRGs or risk-based actions levels and represent an acceptable risk at the site.

The false-positive and false-negative decision errors are discussed in Section 4 of the Work Plan.

Decision Error Limits

For the Phase II RI/FS, the allowable probability of making a false-positive decision has been designated as 0.05 (confidence power of 95 percent) and an allowable probability of making a false-negative decision error has been designated as 0.20 (power of 80 percent).

Calculating the Number of Samples Necessary to Determine Risk

The number of sample locations necessary to determine the risk at a unit or a site were estimated using the process presented in Section 4 of the Work Plan. The number of additional sample locations needed to assess risk during the Phase II RI/FS is the difference between the total number of sample locations and the number of locations sampled during the Phase I RI (Table P-1).

Sampling Designs for the Operable Unit-3 Sites

Two types of sampling designs will be used to determine the soil conditions at Site 16. These four sampling designs are as follows:

- stratified random sampling (either whole or partial unit areas, with replacement where sample locations are closely spaced or overlap); and
- systematic random sampling along an axis (with replacement if new and existing sample locations overlap or are closely spaced).

Descriptions of these Phase II RI/FS sampling designs are presented in Section 4 of the Work Plan. The two sampling designs utilize random positioning to produce an unbiased configuration of sample locations. The advantage of a random, unbiased sampling design is that the tolerance limits for false-positive and false-negative decision errors can be applied to the sample data, and the risk decisions can be assigned a level of confidence.

STEP 7 – OPTIMIZE THE DESIGN

Historic site activities, previous site investigation results, and regulatory comments were used to formulate the Phase II RI/FS sampling approach. Shallow and deeper subsurface soils will be investigated at this site using a tiered sampling approach. This sampling approach consists of three tiers.

Table P-1
Summary of Phase II RI/FS OU-3 Soil Sampling Strategies

Description	Unit Area	Estimated Risk[a]	Number of Locations/ Samples[b]	Number of Phase I Locations/ Samples	Number of Phase II Locations/ Samples[c]	Tier	Type of Sampling Strategy
Site 16–Crash Crew Pit No. 2	Unit 1–16,250 ft^2	< 10^{-6} (0.59) (F)	12(36)	3(5)	3(9)	1	Stratified Random: partial area
	Unit 2–4,340 ft^2	< 10^{-6} (0.05) (F)	12(36)	3(9)	4(12)	1	Stratified Random: 2/new pits
	Unit 3–10,200 ft^2	< 10^{-6} (0.03)	14(42)	3(8)	3(9)	1	Systematic Random on an Axis

Notes:

[a] These estimated cumulative cancer risk values were developed using Phase I RI data, and COPC-specific risk-based concentrations were developed following completion of Phase I RI activities. Numbers in parentheses are the estimated hazard index values. The "F" in parenthesis indicates sites where the estimated risk may be low, but high residual fuel concentrations are present in soil.

[b] Number of samples based on comparison of estimated cancer risk to Table 4-7 in Phase II RI/FS Work Plan, which correlates four cancer-risk categories to the number of samples needed to determine that risk using the project-specific power and confidence limits. For this column, the first number represents sample locations, and the second number (in parentheses) is the number of samples based on an average of three depth intervals per sample location.

[c] These numbers represent the difference between the number of samples required to determine risk and the number of samples collected as part of the Phase I RI, with the following provisions:
Where Phase II RI/FS sample locations were recommended to determine risk, the area covered by this number of locations was based upon the U.S. EPA risk determination standard of a 40- x 40-meter block per sample location. This corresponds to an area of about 206,700 $feet^2$ for 12 sample locations. If the unit area is greater than this size limit, the maximum specified number of samples, less the Phase I RI number of samples, will be collected during the Phase II RI/FS. If the unit area is less than this size limit, the number of sample locations represents a ratio of the unit area versus the 12-sample area (206,700 $feet^2$) times 12 (e.g., Site 19, Unit 3: [Unit 3 area/206,700 $feet^2$]) x 2 locations = 9 locations needed - 3 Phase I locations = 6 new Phase II RI/FS locations required. Use of this ratio rule should maintain the necessary power and confidence limits at units where fewer samples are collected. At units where the ratio rule is applied, the total number of samples (Phase I and Phase II combined) will never be less than six despite the ratio calculation, to be sure that the minimum number of sample locations necessary for a risk assessment is collected. The number of Phase II RI/FS shallow soil boring locations has been based on three samples per location. However, at Site 8 (Unit 3) and Site 12 (Units 1, 2, and 4), four samples per location will be collected.

- The main focus of the Tier 1 sampling plan will be to determine whether the unit is a risk. The Tier 1 sampling approach will consist of collecting shallow soil samples (less than 10 feet bgs) from a specific number of sampling locations within the unit. The number of sampling locations has been proposed such that when the Phase I and II RI/FS data are evaluated together, an assessment of risk can be completed for the unit.
- The Tier 2 sampling approach will also focus on shallow soil; however, the primary objective will be to refine the extent of shallow soil that has been impacted by site activities, by focusing on subareas of the unit where COPCs exceeded PRGs as identified by the Tier 1 sampling and/or Phase I RI/FS results.
- The Tier 3 sampling approach has been designed to estimate the horizontal and vertical extent of impacted subsurface soil (greater than 10 feet bgs). This sampling strategy will only be implemented if Phase I RI/FS soil sample analytical data or Phase II RI/FS Tier 1/Tier 2 soil sample analytical data suggest impacted soil exists at depths greater than 10 feet bgs. Groundwater will be investigated if Phase I or Phase II soil data indicate potential impacts to groundwater are possible.

The tiered sampling approach is detailed in the following sections and in the FSP, Attachment P (BNI 1995). For a list of all soil sampling and analysis at Site 16, see Table P-2.

Tier 1

The Tier 1 sampling will be collection of shallow samples from each unit within the site as described below.

TIER 1 SOIL SAMPLING

Tier 1 sample locations within the three units will be positioned using stratified random sampling or systematic random sampling locations on an axis designs to support the risk assessment and to characterize additional areas not sampled as part of the Phase I RI/FS (Figure P-2).

Unit 1: The Pit Perimeter Area

The objectives of this investigation are to confirm Phase I RI results and collect data to support a risk assessment so that a recommendation for Early Action can be made.

During the Phase I RI, three locations were sampled in Unit 1. The results of this investigation indicated the presence of fuel petroleum hydrocarbons and various VOCs and SVOCs in shallow soil.

In the Phase II RI/FS, Tier 1 soil samples will be collected at 0, 5, and 10 feet bgs from three stratified random sample locations around the perimeter of the three pits (Figure P-2). All soil samples will be field screened for polynuclear aromatic hydrocarbons (PAH) by immunoassay test kits (U.S. EPA Method 4035), and for VOCs

Table P-2
Soil Sampling and Analysis

Tier	Unit/Name	PHASE II RI/FS SAMPLE NUMBERS			FIELD[a] - IMMUNOASSAY OR MOBILE LABORATORY					OFF-SITE LABORATORY[b]		
		No. of Locations	Samples/ Location	Total Samples	PAH[c]	VOCs[d]	BTEX[d]	TPH Gas and Diesel[d]	Target Analyte List - Metals[d]	PCBs and Pesticides	Herbicides	Others: Dioxins, Dibenzofurans, T. Phosphate
Tier 1	Unit 1 - Pits Perimeter Area	3	3	9	X	X	X	X	X			X
	Unit 2 - Fire-Fighting Pits	4	3	12	X	X	X	X	X			X
	Unit 3 - Drainage Channel	3	3	9	X				X			
Tier 1 Subtotals				30	30	21	21	30	30			21
Tier 2	Optional: Scope of Tier 2 would be to further define extent of shallow soil contamination; based on Tier 1 data and Phase I RI findings, with approval of BCT											
Tier 3	Optional: Scope of Tier 3 would be to characterize horizontal and vertical extent of contamination below 10 feet depth; based on Tier 1 and 2 data, combined with the Phase I RI findings, with approval of BCT											

Notes:
[a] three samples from Units 1 and 2 go to the off-site laboratory for confirmation analyses
[b] these constituents cannot be determined in the field; all samples to be analyzed for these constituents will be sent to the off-site laboratory
[c] immunoassay analyses
[d] mobile laboratory analyses

(U.S. EPA Method 8010), benzene, toluene, ethylbenzene, and xylenes (BTEX) (U.S. EPA Method 8020), total petroleum hydrocarbons (TPH) (U.S. EPA Method 8015M), and TAL metals (U.S. EPA Method 6000/7000) by a mobile laboratory. For quality assurance/quality control (QA/QC) support and verification, three samples (two detects and one nondetect) will be submitted to the fixed-base laboratory to confirm field screening results. These fixed-base analyses are PAH (U.S. EPA Method 8310), VOCs (U.S. EPA Method 8010), TPH (U.S. EPA Method 8015M), and TAL metals (U.S. EPA Method 6000/7000) under Naval Facilities Engineering Service Center (NFESC; formerly known as NEESA) Level D protocols. Attachment P in the FSP (BNI 1995) provides the sampling procedures for the Phase II RI/FS at Site 16, Unit 1.

Unit 2: Fire-Fighting Pits

The objectives of this investigation are to confirm Phase I RI results, and collect data to support a risk assessment so that a recommendation for Early Action can be made.

During the Phase I RI, four locations were sampled in Unit 2. The results of this investigation indicated the presence of fuel petroleum hydrocarbons and various VOCs and SVOCs in shallow soil. Significant TFH contamination is present to depths of approximately 60 feet bgs in the area of boring 16AB213.

In the Phase II RI/FS, Tier 1 soil samples will be collected at 0, 2, 5, and 10 feet bgs at four stratified random sample locations (two in the handheld pit, and two in the residuals pit) (Figure P-2). All soil samples will be field screened for PAH by immunoassay test kits (U.S. EPA Method 4035), and for VOCs (U.S. EPA Method 8010), BTEX (U.S. EPA Method 8020), TPH (U.S. EPA Method 8015M), and TAL metals (U.S. EPA Method 6000/7000) by a mobile laboratory. For QA/QC support and verification, three samples (two detects and one nondetect) will be submitted to the fixed-base laboratory to confirm field screening results. These fixed-base analyses are PAH (U.S. EPA Method 8310), VOCs (U.S. EPA Method 8010), BTEX (U.S. EPA Method 8020), TPH (U.S. EPA Method 8015M), and TAL metals (U.S. EPA Method 6000/7000) under NFESC Level D protocols. Attachment P in the FSP (BNI 1995) provides the sampling procedures for the Phase II RI/FS at Site 16, Unit 2.

Unit 3: Drainage Channel

The objectives of this investigation are to confirm Phase I RI results and to collect data to support a risk assessment so a recommendation for NFI, Early Action, or Long-Term Action can be made.

During the Phase I RI, three locations were sampled in Unit 3. The results of this investigation indicated the presence of fuel petroleum hydrocarbons and various VOCs and SVOCs in shallow soil.

In the Phase II RI/FS, Tier 1 soil samples will be collected at 0, 5, and 10 feet bgs at three systematic random sample locations on an axis (Figure P-2). All soil samples will be submitted to the fixed-base laboratory for chemical analyses. These fixed-base analyses are PAH (U.S. EPA Method 8310), VOCs (U.S. EPA Method 8010), TPH (U.S. EPA

Method 8015M), and TAL metals (U.S. EPA Method 6000/7000) under NFESC Level D protocols. Attachment P in the FSP (BNI 1995) provides the sampling procedures for the Phase II RI/FS at Site 16, Unit 3.

Tier 2

The primary objective of the Tier 2 sampling program is to refine the extent of impacted soil identified within each unit by Phase I and/or II RI/FS sampling results. The Tier 2 sampling program will focus exclusively on shallow soil (0 to 10 feet depth) conditions and will further investigate subareas within the unit boundary that exceed PRGs.

The Tier 2 sampling plan will be developed after an evaluation of Phase I RI/FS and/or Phase II RI Tier 1 analytical results. If a Tier 2 sampling program meets the DQOs for this unit, the decision to proceed will be based upon the criteria described in DQO Steps 2, 3, and 5. The proposed Tier 2 sampling plan, with recommendations, will be reviewed by the Base Realignment and Closure (BRAC) Cleanup Team (BCT). The BCT will decide whether the proposed Tier 2 sampling program will be implemented by the Navy.

TIER 2 SOIL SAMPLING

As noted, the objective of a Tier 2 sampling program is to refine the extent of impacted shallow soil within the unit being investigated. The rationale for accomplishing this objective depends primarily on the size and layout of the unit. Where the unit is a linear feature such as a drainage ditch, the Tier 2 program will focus sampling along the trend of the ditch bracketing the Tier 1 sampling locations (or Phase I RI/FS sample locations) where analyte concentrations exceeding PRGs are reported.

For units of rectangular, roughly circular, or irregular dimensions, a systematic random sampling based on a grid, stratified random sampling, or judgmental sampling approach will be used to define the extent of the Tier 1 sample location(s) where analyte concentrations exceed PRGs. The limits of the area covered by these sampling approaches will be contingent upon the distribution of adjacent Tier 1 sample locations in which the COPCs were not detected.

The number of Tier 2 sampling locations (i.e., grid spacing) will be selected to achieve the following objectives:

- provide the areal coverage necessary to define the extent of shallow impacted soil; and
- minimize the cost associated with field and fixed-base laboratory sample testing.

The spacing between sampling locations for Tier 2 will be contingent upon the estimated size of the area to be investigated, and the spacing between Phase I or II RI/FS sample locations. Tier 2 soil sample depth intervals and chemical analyses will conform to those specified for Tier 1 soil sampling.

Tier 3

The Tier 3 sampling program will only be implemented at a unit where Phase I RI data, or the initial evaluation of the Phase II RI Tier 1 and/or Tier 2 sampling program results suggest that soil contamination may extend to depths greater than 10 feet bgs. At least three deep borings are proposed in this Work Plan to further assess subsurface soil conditions beneath Unit 2 in the area around boring 16_AB213.

The objectives of the Tier 3 sampling program are to estimate the horizontal and vertical extent of impacted subsurface soil (greater than 10 feet bgs) and assess whether groundwater beneath the site has been impacted by historic site activities. If impacted subsurface soil is limited to the vadose zone above the water table or vadose zone modeling does not suggest a potential for COPCs to impact groundwater, then groundwater quality will not be investigated.

The Tier 3 sampling plan will be developed after an evaluation of Phase I RI/FS and Phase II RI Tier 1 and/or 2 analytical results. If a Tier 3 sampling program meets the DQO for this unit, then the decision to proceed will be based upon the criteria described in DQO Steps 2, 3, and 5. The proposed Tier 3 sampling plan, with recommendations, will be reviewed by the BCT. The BCT will decide whether the proposed Tier 3 sampling program will be implemented.

Optimization of Sampling Plan

As soil analytical data becomes available from sampling in each unit, investigative plans for the site will be optimized. The proposed tiered sampling approach is an iterative process that will permit data from one tier to be evaluated prior to the implementation of the next tier of sampling. The iterative process involves review of data, recommendations for further actions, and approval of the BCT. In this way, the investigation can be optimized by performing the least amount of sampling necessary to assist the decision-making process about future actions at the unit (i.e., NFI, Early Action, and Long-Term Action).

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WORK PLAN APPENDIX Q

DATA QUALITY OBJECTIVES
OPERABLE UNIT 2 –
SITE 17 – COMMUNICATION STATION LANDFILL

SUMMARY

STEP 1 – STATE THE PROBLEM

The problem at Site 17, the Communication Station Landfill, is to determine which components of the United States Environmental Protection Agency presumptive remedies (which include capping, groundwater treatment, gas control and treatment, or deed restrictions) are appropriate.

STEP 2 – IDENTIFY THE DECISION

Decisions to be considered regarding environmental conditions at Site 17 are the following: Are solid wastes exposed? Have the limits of the landfilled wastes been defined? Are the action levels for ambient air exceeded? Has the landfill impacted surface water or sediment? Have principal waste "hot spots" been identified within the landfill? Do data indicate that leakage from the landfill has impacted groundwater? Do data indicate that leakage from the landfill has impacted the subsurface soil? Has the nature and extent of chemicals of potential concern in groundwater been defined? Do data indicate that sensitive habitats have been impacted?

STEP 3 – IDENTIFY THE INPUTS AFFECTING THE DECISION

Inputs necessary to make the decisions listed in Step 2 include a list of chemical constituents to be analyzed; an assessment of subsurface soil to estimate potential landfill leakage; a definition of limits of the landfilled wastes; an assessment of potential hot spots and the nature and extent of chemicals of potential concern in groundwater; landfill gas emissions; and assessment of ecological risk to the sensitive habitats.

STEP 4 – DEFINE THE BOUNDARIES OF THE STUDY

The study is geographically limited to the Communication Station Landfill.

STEP 5 – DEVELOP A DECISION RULE

Action levels developed for decision-making purposes are a cumulative excess cancer risk of 10^{-6} in humans, a hazard index of 1.0 for chronic systemic toxicity in humans, and a hazard index of 1.0 for acute and chronic toxicity for other organisms in the environment. Based on these risk levels, decision rules are developed to protect human health and the environment in residential, industrial, and recreational land use scenarios.

STEP 6 – SPECIFY LIMITS ON UNCERTAINTY

The sampling designs proposed for Site 17 are areal systematic random sampling and judgmental. An areal systematic random sampling design will be used to characterize the nature and extent of a problem and detect hot spots. The initial round of sampling will be on a 200-foot grid spacing, providing an 80-percent confidence of hitting a circular hot spot having a radius of 100 feet (Gilbert 1987). Judgmental sample locations will be based on previous data and regulatory guidelines.

STEP 7 – OPTIMIZE THE DESIGN

Samples to be collected for the Phase II Remedial Investigation/Feasibility Study will support the remedial response for municipal landfill sites. Activities to be performed will include surface geophysics, soil gas sampling, air sampling, vadose zone sampling, groundwater sampling and well installation, and ecological risk assessment sampling.

ACRONYMS/ABBREVIATIONS

bgs	below ground surface
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	*Code of Federal Regulations*
COPC	chemical of potential concern
DB	dichlorophenoxybutyric acid
DDD	dichlorodiphenyldichloroethane
DDE	dichlorodiphenyldichloroethene
DDT	dichlorodiphenyltrichloroethane
DQO	data quality objective
EM	electromagnetic
FMD	Facility Management Department
FS	Feasibility Study
MCAS	Marine Corps Air Station
µg/kg	micrograms per kilogram
µg/L	micrograms per liter
mg/kg	milligrams per kilogram
MSL	mean sea level
ND	nondetect
NFRAP	No Further Response Action Plan
NFI	No Further Investigation
PCB	polychlorinated biphenyl
$\%_v$	percent by volume
ppb_v	parts per billion by volume
ppm_v	parts per million by volume
PRG	(U.S. EPA Region IX) Preliminary Remediation Goal
RD	Remedial Design
RI	Remedial Investigation
RI/FS	Remedial Investigation/Feasibility Study
SAIC	Science Applications International Corporation
SCAQMD	South Coast Air Quality Management District
SVOC	semivolatile organic compound
SWAT	solid waste assessment test

ACRONYMS/ABBREVIATIONS (continued)

TAL	target analyte list
TFH	total fuel hydrocarbons
TOC	total organic compound
TPH	total petroleum hydrocarbons
TRPH	total recoverable petroleum hydrocarbons
U.S. EPA	United States Environmental Protection Agency
VOC	volatile organic compound

Continue

Appendix Q

SITE 17 - COMMUNICATION STATION LANDFILL

The United States Environmental Protection Agency (U.S. EPA) developed the data quality objectives (DQO) process as a tool for project managers to determine the type, quantity, and quality of data needed to make decisions. Data produced by sampling and monitoring activities are used extensively in problem definition, rule-making, and enforcement decisions. These activities are supported through implementation of the mandatory U.S. EPA Quality System, which requires all organizations to develop and operate management processes and structures for assuring that the data collected are of the necessary and expected quality for their desired use. (U.S. EPA 1993a)

The U.S. EPA DQO process consists of the following seven steps:

1. **State the problem:** Describe the problem at the site as it is currently understood. The problem statement includes a site conceptual model and an organization and review of all relevant data.
2. **Identify the decision:** Determine an if-then statement that will define what the investigation will seek to determine and what actions will be taken based on the possible outcomes of the investigation.
3. **Identify inputs into the decision:** Specify the exact analytes or parameters to be measured and used.
4. **Define the study boundary:** Delineate the study boundary from information obtained from Step 1.
5. **Develop a decision rule:** Restate the decision detailing the if-then statement in specific terms.
6. **Specify acceptable limits on decision errors:** Specify how the data will be treated statistically and what the acceptable limits of uncertainty are.
7. **Optimize the design:** Design the field investigation, giving adequate consideration to the results of Steps 5 and 6. This step is described in more detail in the Field Sampling Plan.

The following sections describe the DQO process for Site 17 – Communication Station Landfill.

STEP 1 – STATE THE PROBLEM

At Site 17, bromodichloromethane, chlorodibromomethane, chloroform, and arsenic have been detected in the one groundwater monitoring well at levels exceeding risk-based screening criteria. Because there is only one groundwater monitoring well at the landfill, the landfills impact on water quality is unknown. Data also suggest that landfill gas emissions exceed South Coast Air Quality Management District (SCAQMD) Rule 1150.1 action levels. The landfill is uncapped, and it exposes wastes in some locations. Special-status species have also been identified at Site 17. The problem at Site 17, Communication Station Landfill, is to determine which components of the U.S. EPA presumptive remedies (e.g., capping, groundwater treatment, gas control and treatment, or deed restrictions) are appropriate and potential mitigation of ecological risks.